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A Manual of Surgical Treatment

BY

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NEW EDITION

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In Five Volumes

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*The Treatment of the Surgical Affections of the Pancreas, Liver and Spleen, the Neck,
the Breast and Thorax, and the Genito-Urinary Organs.*

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TO
THE RIGHT HON.
LORD LISTER, O.M., LL.D., F.R.S.
THE FOUNDER OF MODERN SURGERY
WITHOUT WHOSE WORK MUCH OF THIS BOOK
COULD NOT HAVE BEEN WRITTEN.

PREFACE

TO

REVISED EDITION.

SINCE the first edition of this work was published many changes have naturally occurred in the field of Surgical Treatment. Attempts have been made from time to time to incorporate the most essential of these in successive impressions, but it is always difficult to interpolate new matter of this kind satisfactorily without extensive revision of the entire work. It has therefore seemed best to revise the matter throughout and to alter in it whatsoever was necessary to bring it up to date. The original scheme of the work has been adhered to; to depart from it would have been to abandon the fundamental idea upon which it was based. Every part of the book, however, has been thoroughly revised, and a considerable part has been re-written.

The pressure of other work rendered it impossible for the original authors to undertake a task of such magnitude with any hope of being able to complete it within a reasonable time. In Messrs. T. P. Legg and Arthur Edmunds they have been fortunate in securing collaborators who have rendered their task possible, and to them they are under a great obligation. To their colleagues Dr. Silk, Dr. D'Este Emery, Dr. Arthur Whitfield and Mr. A. D. Reid, they are also much indebted for help in the several departments of treatment with which these gentlemen are specially concerned. Mr. Arthur Edmunds, in addition to his share in the revision, has provided a number of the new illustrations; Messrs. F. Butterworth and S. A. Sewell have drawn the remainder.

Messrs. Down Bros., Allen & Hanburys, Barth, and others have kindly allowed the reproduction of many instrument blocks from their catalogues. Other figures have been reproduced by permission of their authors or publishers, and the source from which they are derived will be found duly acknowledged in the text.

LONDON, 1913.

AUTHORS' PREFACE

TO

THE FIRST EDITION.

THE subject of Surgery has now become so extensive that any work attempting to deal with it in an exhaustive manner must necessarily be so large and unwieldy as to be suitable only for purposes of reference, or for the use of those who devote themselves exclusively to its practice. In any text-book of convenient size the information given in certain branches of the subject must therefore be considerably condensed, and, as the first essential for the beginner is to have the fullest knowledge of the nature and characters of the diseases that he has to study, special stress is usually laid upon pathology, symptomatology, and diagnosis. For the practitioner, on the other hand, who is already acquainted with these points, the great essential is full and detailed information as to the best methods of treatment.

We have ourselves frequently experienced the want of detailed information, especially as regards the after-treatment of our cases, and have had to learn the best methods of procedure from experience. Nothing can of course replace experience, but it is often of the greatest advantage to have a detailed record of that of others upon which to base one's work. It is this want that the present work is intended to supply. We have tried to put ourselves in the place of those who have to treat a given case for the first time, and we have endeavoured to supply them with details as to treatment from the commencement to the termination of the illness. We have assumed that the reader is familiar with the nature and diagnosis of the disease, and we only refer to the pathology and symptoms in so far as it is necessary to render intelligible the principles on which the treatment is based, and the various stages of the disease to which each particular method is applicable.

We have purposely avoided attempting to give anything like a complete summary of the various methods of treatment that have from time

to time been proposed: to do so would merely confuse the reader. Only those plans are described which our experience has led us to believe are the best, but with regard to these we have endeavoured to state exactly and in detail what we ourselves should do under given circumstances. In some cases no doubt several methods of treatment are of equal value, and while we have discussed at length that which we have ourselves been led to adopt, we have referred shortly to the others.

We have not mentioned all the exceptional conditions that may be met with, but we have endeavoured to include all the circumstances with which the surgeon is most commonly called upon to deal. The task has been one of some difficulty, the more so as we have had, to a certain extent, to break new ground. This must serve as our excuse for the many shortcomings in the work.

LONDON, *April*, 1899.

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DIVISION I.

THE SURGICAL AFFECTIONS OF THE PANCREAS, LIVER, AND SPLEEN

CHAPTER I.

THE SURGICAL AFFECTIONS OF THE PANCREAS.

INJURIES.

THESE are comparatively rare and of no great surgical importance because they are practically always accompanied by other injuries, such as rupture of the stomach, liver, or spleen, whether the injury be the result of a direct blow or crush, or of a wound caused by a sharp instrument or a bullet. The injury to the pancreas is generally only recognised during life in the course of an operation for a severe abdominal injury, although in penetrating or bullet wounds it may be suspected from the direction of the wound. The surgeon should, however, bear the possibility of damage to the pancreas in mind when he has to deal with a severe abdominal injury.

The pancreas may be bruised, ruptured, or so damaged that gangrene will follow; its vessels or duct may also be torn, and there may be bleeding into its substance, beneath its capsule, or into the general abdominal cavity. Pancreatitis may result, and may end in suppuration and pyæmia, or may follow a more chronic course. Blood-cysts and true pancreatic cysts (see p. 6) are not uncommon after a contusion.

TREATMENT.—There is little to say concerning the treatment of injuries of the pancreas *per se*. Should the abdomen be opened for

severe internal bleeding and the source of hæmorrhage be difficult to determine, the pancreas must be examined, and any bleeding points secured; the best mode of gaining access to the pancreas is to tear through the omentum between the stomach and the transverse colon. Punctured or incised wounds may be closed by a suture inserted fairly deeply into the substance of the gland, which will also serve to stop bleeding. In the case of lacerated wounds it may be necessary to under-run the bleeding area with catgut and then suture the edges of the wound. If this is not possible, the bleeding point should be clamped with forceps, which are left on for forty-eight hours. When the duct of Wirsung is injured, an attempt should be made to stitch up the wound in it or, at any rate, to bring the tissues together over it so as to prevent leakage. Any blood in or around the pancreas should be mopped up so as to avoid the subsequent formation of a blood-cyst.

In all these cases it is well to provide free drainage by means of tubes, which should be packed around with gauze, so as to cause adhesions and shut off the general peritoneal cavity from the track through which the discharge escapes. This is also advisable when the organ is much contused because gangrene may follow such an injury.

A traumatic hernia or *prolapse* of the organ may occur when there is an open wound leading down to the pancreas. Under such circumstances the prolapsed portion should be cleansed and reduced, and a drainage tube and gauze packing inserted down to the bottom of the wound.

INFLAMMATORY AFFECTIONS.

Various forms of acute pancreatitis—such as simple acute pancreatitis, hæmorrhagic, gangrenous, and suppurative pancreatitis—may be met with; chronic pancreatitis may also occur.

ACUTE PANCREATITIS.

The cause of this very fatal disease is undoubtedly bacterial infection, but the exact manner in which the infection is brought about varies in different cases. The extrinsic causes most frequently at work are hepatic or pancreatic lithiasis or gastro-duodenal catarrh. The infection commences in the ampulla of Vater and spreads upwards to the duct of Wirsung; the organism most often isolated is the *Bacillus coli communis*, but other organisms may also set up the disease. The acute form of the affection may be divided into three groups—namely, the hæmorrhagic, the gangrenous, and the suppurative varieties; it is also usual to speak of a sub-acute form.

The *symptoms* of the disease are frequently mistaken for those of acute

intestinal obstruction—at any rate, in the early stages—and the correct diagnosis is often not made until the abdomen has been opened. The disease sets in with sudden acute pain in the epigastrium, accompanied by profound collapse and, very soon, by severe vomiting. The vomiting, although generally very severe and painful, does not become feculent; there is often jaundice, and a characteristic feature is that the patient may become intensely cyanosed. There is a variable amount of constipation, and tympanites soon occurs in the upper part of the abdomen. The abdomen is very tender above the umbilicus and the recti are very rigid and prevent palpation of the pancreas. Death usually occurs within five days and is often preceded by delirium. The affection has many symptoms in common with acute intestinal obstruction, perforation of the stomach or duodenum, septic cholecystitis, and gangrenous appendicitis; all these conditions demand immediate laparotomy, and therefore it is not necessary to lose time in making an exact diagnosis.

When the abdomen is opened, the presence of *fat necrosis*, which is a very frequent accompaniment of the disease, may make the nature of the condition evident. In this condition the normal fat is split up by the fat-splitting ferment of the pancreas into glycerine and fatty acids; the glycerine is absorbed, while the fatty acids remain in the fat cells, and, combining with calcium salts, give rise to the yellowish-white patches so characteristic of this affection. As a rule the change takes place in the fatty structures in the immediate vicinity of the pancreas, but occasionally it occurs at a considerable distance from it, *e.g.* in the pericardium. This condition is generally, though not invariably, present in cases of hæmorrhagic pancreatitis, less frequently in the gangrenous form, and only comparatively rarely in the suppurative variety; further, it is not confined to cases in which pancreatitis is present.

Acute hæmorrhagic Pancreatitis.—This is the variety of acute pancreatitis most frequently met with in practice, but the exact significance of the hæmorrhage is not apparent. By some it is thought to be due to the violence of the septic infection, by others it is looked upon as the primary condition, the sepsis being secondary to it.

Gangrenous Pancreatitis.—This condition very closely resembles that just described, but hæmorrhage is absent, there is less fat necrosis and the pancreas is found to be actually gangrenous at the time of operation, or becomes so subsequently.

Acute suppuration may occur either in or around the organ, and may result in a localised abscess, or disseminated abscesses, or may occur as a diffuse infiltration of the pancreatic tissues with pus. When there are a number of abscesses the affection is generally pyæmic, and the true diagnosis will probably not be made, or if made, cannot lead to any successful result. The only suppurative condition for which surgical intervention offers any hope is that of circumscribed abscess in or

around the pancreas. In these cases, too, the diagnosis is extremely difficult. The symptoms may be very acute at the onset, and then subside to some extent, leaving only localised pain and tenderness in the epigastrium; later on a swelling forms in the region of the pancreas, frequently accompanied by symptoms referable to organs, such as the stomach or the liver, in the immediate neighbourhood; jaundice not being infrequent. The progress of the affection is not so rapid as in either of the preceding varieties and the prognosis is more favourable.

TREATMENT.—This practically always takes the form of an exploratory laparotomy followed by free drainage. In the *acute hæmorrhagic cases* the patient may be so profoundly collapsed when he is seen that an immediate laparotomy would certainly prove fatal. Under these circumstances, it will be well to wait for a short time, employing meanwhile suitable remedies for the shock (see Vol. I. p. 118). If the patient rallies, a vertical incision is made through the upper part of the right rectus and the true nature of the case is ascertained. The area of the pancreas is opened up by tearing through the gastro-colic omentum, and a free exit is provided for the inflammatory products by means of large drainage tubes passed down to the pancreas, packed round with gauze, and emerging from the abdominal opening. If the case turns out to be one of *gangrenous pancreatitis*, very free exit must be provided for the escape of the sloughs, and it is therefore well to make a counter-opening at the most dependent point, generally in the loin (*vide infra*). Few patients recover who are the subjects of either the hæmorrhagic or gangrenous form of the disease.

In a few instances *abscesses of the pancreas* have been successfully treated by drainage. When the abscess has been reached in the manner described above, it is opened by a small incision after carefully packing off the surrounding peritoneal cavity and the pus is mopped up as fast as it escapes. Retro-peritoneal opening of the abscess has been practised through a lumbar incision, but it is very difficult to cut down from the loin directly on to an abscess in the pancreas, more particularly when the diagnosis is as uncertain as it generally is, and the best plan appears to be to open it first from the front, and then ascertain by means of a long probe, or the finger passed into the abscess cavity, whether it projects into the loin, and whether, therefore, it is possible to reach it by a lumbar incision. If this is the case, more satisfactory drainage can be secured by making a counter-opening at the most dependent point; the end of the probe is cut down upon from behind, and large drainage tubes are inserted, while a single large tube, packed round with gauze, is placed in the anterior opening and emerges through the abdominal incision. When adhesions have formed in front and shut off the general abdominal cavity, the anterior tube and the packing are withdrawn and the wound allowed to heal, while drainage is continued through the posterior opening.

CHRONIC PANCREATITIS.

This affection may occur as a result of extension of inflammation from a gastro-duodenal catarrh or a duodenal ulcer, or it may arise in connection with calculi in the bile and pancreatic ducts, or possibly after an injury.

The *symptoms* are very indefinite. The most marked are flatulent dyspepsia, loss of flesh and strength, pain in the epigastrium, and sometimes jaundice when the head of the pancreas is affected and the common bile-duct is pressed upon. The pain is complained of in the mid-line in front and between the scapulæ behind. There is often diarrhœa with offensive motions containing undigested food; albuminuria and glycosuria may be present in advanced cases. The gall-bladder may be distended.

The diagnosis of this affection is by no means easy. In the slighter cases chronic pancreatitis is very apt to be confounded with catarrhal jaundice or biliary lithiasis; in the severe ones, with cancer of the head of the pancreas or the gall-bladder. Even after laparotomy, the diagnosis is by no means easy and it has happened that cholecystenterostomy has been done for the relief of persistent jaundice in cases which were regarded at the time as cancer of the pancreas, and recovery has followed, the probable explanation being that the case was one of chronic pancreatitis. The urinary tests seem to be most unsatisfactory.

TREATMENT.—When this condition is suspected, the abdomen should be opened by a free vertical incision through the upper part of the right rectus and a full examination made. Care must be taken to make sure that there are no gall-stones in the common duct, as this is the commonest cause of this condition, and the surgeon should only assume the presence of a primary chronic pancreatitis when he is certain that no calculus is present. The induration of the pancreas, especially of its head, can be easily ascertained with the fingers.

When it is quite certain that no calculus exists, the best plan is to drain the gall-bladder for some weeks until the obstruction to the flow of the bile into the intestine—as shown by the nature of the stools—has quite subsided. For this purpose a cholecystostomy (see p. 47) is performed, and drainage of the gall-bladder kept up for at least three or four weeks; if there is no jaundice at the end of that time, and the bile is normal and passes freely into the intestine, the tube is withdrawn and the opening allowed to close.

An operation sometimes performed for this condition is cholecystenterostomy (see p. 57). Apart from the risk of septic infection spreading from the bowel to the bile passages, it has been found that the operation has been more than once followed by recurrence of symptoms.

CALCULI.

These are usually composed of phosphate and carbonate of lime ; they lie in the duct of Wirsung, and cause marked alteration in the pancreatic tissues, which sometimes takes the form of fatty degeneration, at others of chronic pancreatitis. The duct may be dilated behind the calculus and a cystic swelling is thus formed.

These concretions are probably due to some alteration in the consistency of the secretion or some interference with its escape. The diagnosis is almost impossible without exposure of the pancreas, although the calculi are opaque to the X-rays. The chief symptom is pain, which is either continuous or colicky, and is most frequently referred to other organs, such as the liver. There may be pyrexia, and glycosuria is not uncommon; the presence of colicky pains in the neighbourhood of the pancreas, together with the presence of sugar in the urine, may lead to the diagnosis. When the obstruction is complete, fatty stools occur, and sometimes jaundice is present when the calculus presses upon the common bile-duct. As a rule, however, it is only after laparotomy that the stone is diagnosed, and even then, it may lie in the head of the pancreas in the midst of a mass of cicatricial tissue, and a diagnosis of malignant disease may be made.

TREATMENT.—Should the presence of a stone be recognised, an attempt should be made to remove it by making an incision directly over the stone, extracting it, and then stitching up the incision in the pancreas, free drainage being provided through the anterior abdominal wall by means of a large-sized drainage tube packed around with gauze.

CYSTS.

Cysts are met with in the pancreas at all ages, but are most frequent between twenty and forty years of age. The following varieties may be mentioned : retention cysts, proliferation cysts (cystic adenoma or epithelioma), hydatid cysts, congenital cystic disease, and blood-cysts.

The pathology of these various kinds of cysts is fairly obvious. The retention cyst is caused by the impaction of a calculus in, or a stricture of or pressure upon, the duct of Wirsung. The proliferation cysts may be either innocent or malignant. Hydatid cysts are very rare, as is also congenital cystic disease. Blood-cysts may follow an injury which is not sufficiently severe to cause death ; after a varying interval, the presence of a cystic tumour in the situation of the pancreas is noticed. Pancreatic cysts containing blood-stained fluid must not, however, be looked upon as having necessarily originated from an injury, for it is common to find blood in cysts of non-traumatic origin.

Pseudo-cysts.—Apart from true pancreatic cysts, other collections of fluid are met with in this region which are clinically indistinguishable

from true pancreatic cysts. The commonest form is an effusion into the lesser sac of the peritoneum with occlusion of the foramen of Winslow.

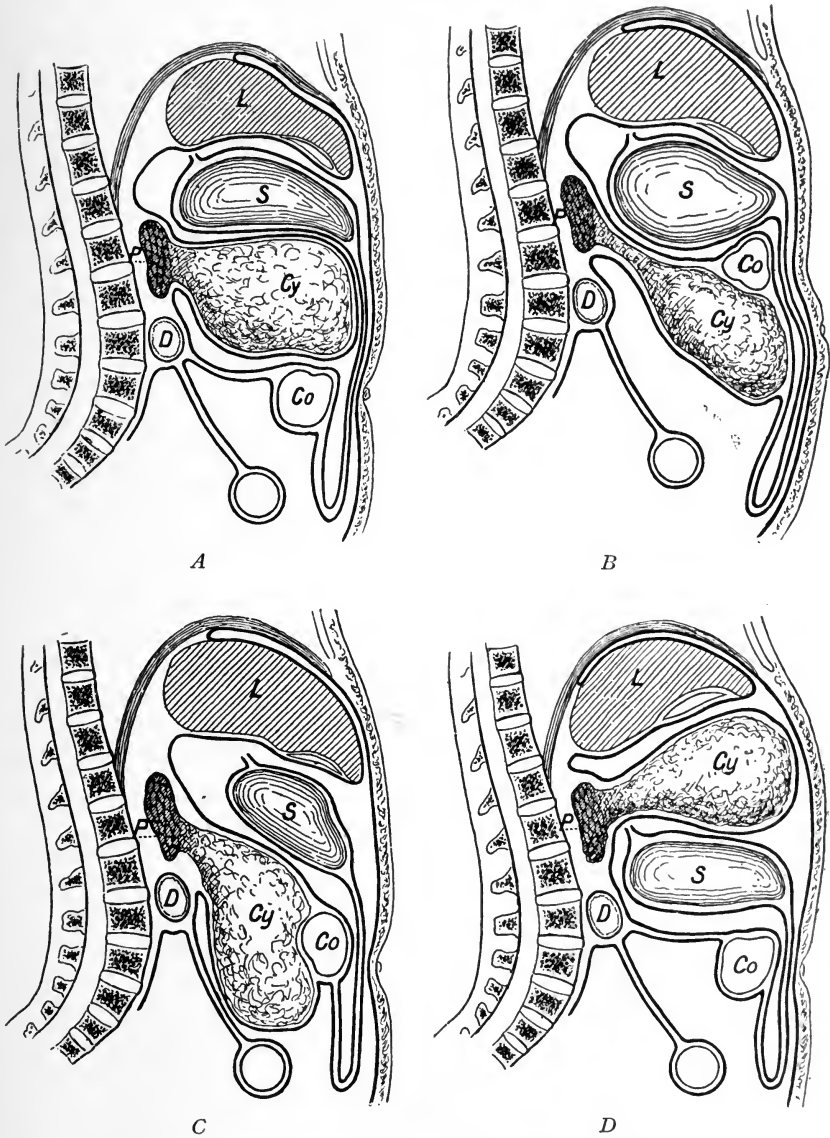


FIG. 1.—DIAGRAMS TO SHOW THE DIRECTION TAKEN BY A PANCREATIC CYST.
L, liver; *S*, stomach; *Cy*, cyst; *D*, duodenum; *P*, pancreas; *Co*, transverse colon.

Cysts may also occur in the omenta, the transverse meso-colon, or behind the peritoneum, and these are probably hæmorrhagic in origin.

The fluid in a true pancreatic cyst is nearly always slightly blood-stained and contains albumen, urea, and cholesterin ; it very rarely consists of pure pancreatic fluid. It is almost always alkaline, is generally somewhat tenacious and slimy, and its specific gravity varies from 1010 to 1020 ; sugar may be present. These cysts may occur anywhere in the gland, but are said to be more frequent in the neighbourhood of its tail. They are retro-peritoneal, and, as they increase in size, they push forward the lesser sac of the peritoneum until the anterior wall of the cyst comes into close proximity with the anterior abdominal parietes. The exact relation of the cyst to the stomach and intestines varies in different cases (see Fig. 1). The commonest condition is for the cyst to find its way forwards between the stomach and transverse colon, the former being pressed up against the liver, and the cyst wall being covered by the anterior layer of the gastro-colic omentum. In other cases, the cyst may find its way forwards below the transverse meso-colon, and in others again above the stomach. A large cyst may cause serious pressure upon the duodenum, the common bile-duct, the aorta, the vena cava, the portal vein, or the solar plexus. The cyst is not mobile ; in any case, only the projecting portion moves with respiration. Transmitted pulsation from the aorta may be marked. The cyst is usually median, but it may lie to the left or, more rarely, to the right of the middle line.

The *symptoms* are usually indefinite ; the patient generally complains of dyspepsia and pain. Symptoms due to interference with the functions of the pancreas may also be present, especially if the cyst is large, *e.g.* wasting, glycosuria, undigested fat in the stools or diarrhoea. The cyst is usually globular, smooth, and very tense and may be mistaken for a solid tumour. It may vary in size, apparently emptying and then re-filling ; whether it empties by rupture or by absorption of the fluid is not clear. If left alone, it will ultimately rupture either into the alimentary canal or into the peritoneal cavity, and recovery may take place. Death, however, may occur from obstruction, hæmorrhage, peritonitis, profound jaundice, diabetes, or wasting ; cysts of pancreatic origin are accompanied by much more marked emaciation and loss of strength than is the case with other cysts, such as hydatids, found in the same region.

The cyst has to be distinguished from one of ovarian or hepatic origin, from an enlarged gall-bladder or spleen, from hydro-nephrosis, from hydatid or hæmorrhagic cysts of the kidney, from aneurysm, and from mesenteric cysts. Any attempt to make the diagnosis by puncture is to be condemned, as the needle may traverse either the stomach or the colon. Puncture should only be carried out, if at all, after exposure of the cyst by opening the abdomen.

TREATMENT.—The methods of treatment at present in vogue are repeated tapplings, incision and drainage, or extirpation of the cyst. The first method is, in our opinion, bad, for the reasons mentioned above ;

apart from the risk, the cyst will fill up again almost immediately. The first step in all cases ought to be to open the abdomen over the most prominent part of the swelling and expose the cyst wall.

As the relation of the cyst to the stomach and the colon varies in different cases, these structures must be identified before proceeding further. In the ordinary form, in which the tumour makes its way forwards between these two structures, a small opening is carefully made in the gastro-colic omentum and the stomach and colon are separated until the thin bluish cyst wall is exposed, any vessels wounded in the process being tied. The abdominal cavity must then be packed off with gauze, and a fine trochar and canula is introduced into the cyst and the bulk of the fluid drawn off so as to avoid flooding the abdominal cavity. The cyst is now opened by a small incision, the edges of which are caught in forceps and pulled well up into the wound; when the fluid has escaped, these edges may be sutured to the abdominal incision after the gauze packing has been removed. A drainage tube is introduced into the opening in the cyst wall and fixed by means of a purse-string suture as is done in cholecystostomy (see p. 47) and an antiseptic dressing is applied. The skin may become irritated by the secretion from a true pancreatic cyst, and this is best avoided by connecting the drainage tube with tubing which passes through the dressing into a vessel containing an antiseptic; in this way contact of the secretion with the skin may be prevented—for a time, at any rate. When the suture cuts its way out, the largest size drainage tube that can be got into the opening in the cyst should be used and the skin around should be smeared with boric ointment.

When the cyst wall cannot be brought up to the skin, a drainage tube is tied in as in cholecystostomy (see p. 47) and packed round with gauze so as to prevent the escape of fluid into the abdominal cavity; the packing is removed in three or four days. In some cases the finger may be passed downwards to the left through the incision; and a counter-opening made beneath the costal margin; through this a drainage tube is introduced into the cyst, and the opening in the anterior wall of the cyst is sewn up. A little gauze packing should be left in the anterior wound for a few days in case leakage should occur.

Healing usually takes from one to four months; the mortality is small. The patient generally recovers his health quickly after the operation; the stomach troubles disappear and improvement in nutrition takes place, even while thin pancreatic juice is still running out of the drainage opening.

In a few cases extirpation of the cyst may be attempted, but this is not possible in retention cysts. Apart from the difficulty of getting proper access to the cyst, serious bleeding is apt to occur, and damage may be done to important structures, so that it is better not to attempt it unless the cyst is almost pedunculated; adhesions between the cyst and neighbouring structures contra-indicate the operation.

NEW GROWTHS.

Tumours of the pancreas are not uncommon, the most common being carcinoma. Other tumours, such as adenomata, or, very rarely, sarcomata, may also be found. The most frequent seat of carcinoma of the pancreas is in the head of the gland, when it may compress the bile-duct and lead to jaundice. Should this be the case, cholecystenterostomy (connecting the gall-bladder with the duodenum) may give relief to the jaundice (see p. 57). When the tumour is large and compresses the pylorus, gastro-jejunostomy may be called for, but these growths generally extend rapidly and are accompanied by great pain, and it is questionable whether the operation is worth while. Attempts have been made to remove the tumour, and when the latter is in the tail of the pancreas and is movable, it may be possible to do this. Tumours in the head of the pancreas practically involve total extirpation of the gland, and this is out of the question. Encapsuled tumours have been removed by tearing through the gastro-colic omentum, opening the peritoneum over the gland and shelling out the growth. It is well to remember that the tendency to imperfect coagulability of the blood—and therefore to serious bleeding after any operative interference—is always very marked in cases of cancer of the pancreas, especially when associated with obstructive jaundice. Therefore no exploratory operation should be done in these cases unless there is some definite prospect of improving the patient's condition.

CHAPTER II.

INJURIES OF THE LIVER AND BILE-PASSAGES.

SURGICAL ANATOMY OF THE LIVER.

IN the healthy adult, the inferior margin of the liver corresponds on the right side to the costal margin, and crosses the epigastrium on a level with a line drawn from the tip of the ninth rib on the right side to that of the eighth left costal cartilage, and then passes upwards and to the left to reach a point near the apex-beat of the heart ; at the linea alba it lies nearly midway between the sternum and the umbilicus. The level of the upper surface may be indicated by a line drawn from the base of the xiphoid cartilage to the right fifth rib in the nipple line, curving downwards to the sixth rib in the mid-axillary line and then backwards to the eighth dorsal spine.

The limits of the right pleural cavity are of importance, especially in connection with puncture of the liver or the opening of hepatic abscesses. In front, the pleura descends to a point just behind the right seventh costal cartilage near the sternum, whilst in the right mid-axillary line it is two or three inches above the costal margin. Behind, it may extend just below the twelfth rib. By removing the tenth rib in the mid-axillary line the pleura can be avoided and the diaphragm exposed.

The relation of the peritoneum to the liver.—The latter structure is not covered by peritoneum posteriorly, and an abscess in that situation may therefore be reached without traversing the peritoneal cavity. The peritoneum is reflected from the under-surface of the diaphragm on to the convexity of the liver posteriorly, as the anterior layer of the coronary ligament, and passes over the anterior surface of the organ and round its lower margin until it reaches the transverse fissure, where it is reflected downwards in front of the structures in the portal fissure to form the anterior layer of the gastro-hepatic omentum. To the right of the portal fissure it becomes continuous with the peritoneum in

front of the right kidney; this reflection is sometimes called the 'hepato-renal ligament.' The posterior layer of the gastro-hepatic omentum when traced upwards is reflected on to the liver at the posterior margin of the portal fissure, covering the caudate and Spigelian lobes.

The liver has five ligaments—namely, the coronary, the suspensory or falciform, the round, and the right and left lateral ligaments. The suspensory ligament is of considerable surgical importance as it serves to limit abscesses in the subphrenic region. It extends from the front to the back of the organ and is continuous behind with the coronary ligament; it surrounds the round ligament below. It consists of two opposed surfaces of peritoneum, and extends upwards from the umbilicus, being reflected above on to the anterior abdominal wall and the diaphragm; it lies a little to the right of the middle line.

The transverse colon, which lies directly in contact with the anterior abdominal wall, encloses a well-defined area of the peritoneum between itself and the liver; extravasations from the liver may therefore be confined to this area without affecting the general peritoneal cavity, provided that the extravasation is slow enough for adhesions to form, which still more effectually limit this space. An extravasation in this area will find its way downwards towards the right iliac fossa outside the ascending colon.

SURGICAL ANATOMY OF THE BILE-PASSAGES.

When in its usual position, the fundus of the gall-bladder lies directly behind the ninth or tenth right costal cartilage, but it is sometimes situated well to the right of this spot. When the gall-bladder is small it may be entirely covered by the edge of the right lobe of the liver, but when enlarged it extends below it and is deflected inwards towards the umbilicus; it may also reach into the lumbar or cæcal regions. These anomalies in position are due not only to changes in size of the organ itself, but also to alterations in the shape and size of the liver and to adhesion of the gall-bladder to neighbouring structures.

As a rule the gall-bladder measures from three to four inches in length and about one and a quarter inches at its broadest part, which is usually situated about two-thirds of the distance from its neck. When diseased its variations in size are extreme. It may be so large as to be mistaken for an ovarian cyst, whilst on the other hand it may be so small as to escape notice except after the most careful search. A point of practical importance is the marked variation in the thickness of its wall; normally it is quite thin, but it may be much thickened as the result of inflammation.

The gall-bladder lies in contact with the hepatic flexure of the colon,

the anterior abdominal wall; and the first and second parts of the duodenum; it usually contains about an ounce of fluid, and should not be felt through the abdominal wall if it is healthy. Although the attachment between the gall-bladder and the liver is normally fairly loose, any inflammation spreading through the walls of the viscus may give rise to firm adhesions. As a rule it is partially invested by the peritoneum which passes from the under-surface of the liver over the under-surface of the gall-bladder; in rare cases a definite mesentery may be present. The mucous membrane about the neck of the gall-bladder and in the cystic duct is thrown into folds, which may embarrass the surgeon when he attempts to pass a probe from an incision in the fundus through the cystic into the common duct.

The cystic duct measures about one and a half inches in length, and passes backwards and slightly downwards and to the left to join the hepatic duct and form with it the common bile-duct. These two structures unite at an acute angle, and it is important to remember that a lymphatic gland is frequently found in the angle between them, and may be enlarged as a result of any inflammatory condition about the parts and may simulate a calculus on digital examination. Similar glands are met with over the common duct, and may also form pitfalls for the surgeon if they are enlarged. Over the common duct also there are numerous small vessels arranged in an abundant plexus, and these may be a source of troublesome hæmorrhage when the duct is incised.

The common duct is usually divided into three parts. The first part lies above the duodenum, is fairly free and accessible, and is about an inch and a quarter in length. The second part lies behind the first part of the duodenum, and is more difficult to get at; whilst the third portion is embedded in the pancreas and is practically beyond the surgeon's reach from outside. In order to expose the second part of the duct, the duodenum and the head of the pancreas must be raised from it.

Owing to adhesions, it is sometimes difficult to identify the common bile-duct after the abdomen has been opened. The simplest way is to trace down the cystic duct from the gall-bladder until it joins the common duct; but when dense adhesions are present this may be difficult, and in that case the best plan is to pull up the anterior margin of the liver so as to rotate that organ upon its transverse axis; and then to feel for the foramen of Winslow, and pass the finger through it. The common duct lies in the free edge of the gastro-hepatic omentum, having the portal vein behind it, whilst the hepatic artery lies behind and to its left side. In the portal fissure the order of the structures from before backwards is duct, artery, and vein.

The gall-bladder acts as a reservoir for bile, and probably fills up during the night and during fasting, and empties itself whilst digestion is in progress. It has been known to be entirely absent, and its complete removal apparently causes no inconvenience.

INJURIES OF THE LIVER.

CONTUSIONS AND RUPTURES.

These injuries are not uncommon ; in fact the liver is the viscus most commonly damaged in crushes or run-over injuries about the upper part of the abdomen. The peritoneal coat of the organ gives way and there is extravasation of blood and bile into the abdominal cavity. This extravasated material tends to collect between the colon and the liver and to pass down towards the right side ; if the extravasation is small in amount and occurs gradually, it may remain limited to that region.

The seriousness of the case depends upon the extent and the situation of the injury. When the larger branches of the hepatic vein are torn, the divided vessels remain patent, and free hæmorrhage results ; indeed, in many cases the patient is already moribund when first seen. In any case the bleeding is apt to be persistent, probably because the admixture of bile with the blood hinders proper coagulation. The amount of bile which escapes will depend upon whether the large bile-ducts are injured or not. The gall-bladder or the bile-passages are not infrequently lacerated.

In severe fractures of the ribs the broken ends of the bone occasionally penetrate the liver substance. Penetrating wounds of this kind are not common, the more usual injuries in connection with a fractured rib being either a simple fissure on the surface of the organ near the anterior margin, a large stellate contusion, or a pulping-up or actual detachment of a portion of the organ.

In bad cases death occurs rapidly from a combination of shock and hæmorrhage. In all patients that survive long enough to come under the notice of the surgeon there is the intense shock so frequently met with in bad abdominal contusions (see Vol. IV.) and in most cases there will also be the signs of hæmorrhage. The *symptoms* special to the injury of the liver are persistent pain over the organ—also referred to the umbilicus, the xiphoid cartilage, or the right shoulder—and extreme tenderness on palpation over the damaged area ; the liver dullness is generally increased, especially on the right side. There may be bilious vomiting followed by jaundice. As a rule the extravasation of a small amount of bile into the peritoneum is not fatal ; but, should this occur in large quantity—as from rupture of the gall-bladder or bile-ducts—it is a serious matter and fatal peritonitis may result ; this is probably due to contamination of the bile by the colon bacillus. Should the bleeding stop spontaneously and the patient recover, absorption of the extravasated material may occur or a blood-cyst may form.

TREATMENT.—This will be influenced largely by the presence or absence of signs of active hæmorrhage.

Palliative.—If the bleeding is not marked, palliative measures may suffice. The patient is put to bed with the knees flexed over a pillow

so as to relax the abdominal muscles, and a large ice-bag or Leiter's tubes (see Vol. I. p. 8) is applied over the right hypochondrium. Should there be vomiting, which tends to keep up the bleeding, it must be checked if possible by giving a mixture containing 1 minim of dilute hydrocyanic acid, 20 grs. of carbonate of bismuth, 15 grs. of bicarbonate of soda, and 2 ounces of hot water every three hours. A strict watch must be kept for symptoms of severe loss of blood, but it is not advisable to inject saline solution unless it is urgently called for, because the hæmorrhage is apt to recur when the blood pressure is raised by the injection, and the coagulating power of blood, when largely diluted with salt solution and mixed with bile, is very defective.

These injuries should be looked upon as extremely serious, and the patient must be carefully watched to see that no fresh hæmorrhage occurs after recovery from the primary shock; should this happen, the only chance of recover lies in immediate laparotomy. Laparotomy is also necessary if the symptoms point to severe hæmorrhage when the case is first seen, and should be carried out whether there is a wound of the abdominal wall or not.

Operative.—It is sometimes said that it is advisable to wait for the patient to recover from the shock before operating for ruptured liver. If, however, there is severe hæmorrhage the patient will never recover from the shock, and, therefore, should the surgeon have reason to believe that active hæmorrhage is proceeding, the patient's only chance is immediate operation irrespective of the amount of shock present. Every precaution for the prevention of shock should be employed (see Vol. I. p. 118), and rapidity of operation is of primary importance, so as to reach and control the bleeding area as quickly as possible.

The abdomen should be opened by a free vertical incision an inch to the right of the linea alba. Further room may be gained if desired by a lateral incision about a finger's breadth below the right costal margin or transversely outwards to the right through the rectus, just above the umbilicus. The surgeon must have plenty of room, and the incision should be made as rapidly as possible.

The edges of the incision should be widely retracted immediately the abdomen has been opened, and the blood rapidly swabbed away so as to ascertain its source. Directly the bleeding area is found, the oozing is stopped by thrusting gauze firmly into the gap so as to give time for the surgeon to investigate the extent and character of the lesion and to arrest the hæmorrhage. It must, however, be admitted that it is often excessively difficult to do this, even after free exposure of the liver, and the surgeon may see the patient steadily losing blood to an alarming or even fatal degree. This must not, however, deter him from operating upon these cases, as operation does not increase the hæmorrhage, whereas it gives the patient the only chance of life.

When there is a clean-cut laceration of the anterior edge of the liver,

attempts to clamp or ligature bleeding vessels on the torn surface of the organ are futile. The surgeon must trust to pressure, and the best way of obtaining this is to insert mattress sutures through the thickness of the liver so as to press the bleeding surfaces together over a large area, in much the same way as for similar injuries in the kidney (see Fig. 2). A large perineal needle threaded with stout catgut is thrust through the capsule some distance from the edge of the wound on one side, is then carried

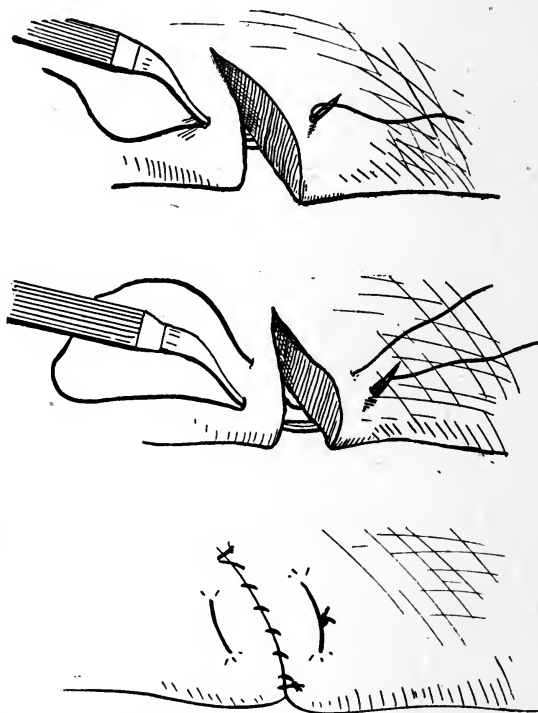


FIG. 2—SUTURE OF A LACERATION OF THE ANTERIOR MARGIN OF THE LIVER. The diagrams show how the sutures are passed through the entire thickness of the liver in order to get a firm compression.

through the whole thickness of the liver, and finally made to emerge at a corresponding point on the opposite side of the wound, where the end of the suture is caught by an assistant. The needle is then withdrawn without unthreading it and passed through the liver a second time in a similar manner an inch or so farther down the line of laceration. When its point emerges at the opposite side, the needle is unthreaded and withdrawn and the suture is tied after the assistant has approximated the torn surfaces. The suture must be tied just tight enough to approximate the cut surfaces without cutting through the friable liver substance; if the capsule is not included in these sutures they cut through at once.

It is well to put in enough sutures to bring the ruptured surfaces accurately in contact everywhere, and the repair of the damage is completed by uniting the capsule throughout by a fine continuous catgut stitch. After this the blood is sponged out of the abdomen and a drainage tube is inserted at the most dependent angle of the wound to enable blood and bile to escape ; the rest of the abdominal wall is then sutured, a loose stitch being inserted where the drainage tube passes through it. It will be advisable to complete the last stages of the operation as rapidly as possible owing to the exhausted condition of the patient, and probably careful suture of the abdominal wall in layers will have to be abandoned in favour of a few mattress sutures taking up the peritoneum and muscles together, the skin being united by a continuous stitch.

When there is a large lacerated area with extensions in various directions, the bleeding cannot be controlled in this manner, and it will be necessary to have recourse to firm packing of the wound. Attempts may be made to under-run and tie any particularly large bleeding vessels, but this is very difficult owing to the friable nature of the liver tissue, and as a rule the hæmorrhage must be controlled by packing strips of gauze as firmly as possible into every recess of the oozing surface ; the end of the packing is brought out through the abdominal incision. The packing must be firmly applied, and further pressure must be exerted by a large pad of dressing externally. Packing is by no means efficient as there is no firm point to press against, but under these circumstances it is the only thing that can be done.

Lacerations of the under-surface and posterior border of the liver are very serious, because large vessels in the hilum of the organ are usually torn and the patient often dies before aid can be summoned. Should he live long enough for a laparotomy to be done, and should a large bleeding vessel be found, all that is possible as a rule is to clamp the bleeding point and leave the forceps on, as the patient will have lost too much blood to justify any attempt at sewing up the rent in the vessel. The wound must be carefully packed with gauze as described above.

In cases of *penetrating wounds of the liver* by stabs and gunshot wounds the external wound should be disinfected, the abdomen opened, and an attempt made to arrest the hæmorrhage. When there is only a small punctured wound in the liver, it may suffice to close it by one or two mattress sutures ; in all cases the abdomen must be opened sufficiently freely to enable the wound of exit to be looked for and treated in a similar manner. In more extensive injuries the arrest of the hæmorrhage is effected on the lines already described (*vide supra*).

Should the patient recover from the effects of the loss of blood, the prognosis is good. Bile in the abdominal cavity rarely gives rise to peritonitis, provided that it does not proceed from a laceration of the gall-bladder or bile-ducts ; when it does so, it may be contaminated with pathogenic organisms.

INJURIES OF THE GALL-BLADDER AND BILE-DUCTS.

Injuries of the gall-bladder and bile-ducts usually occur in connection with injuries of the liver and give rise to similar symptoms, so that the case is generally diagnosed and treated as one of injury of the liver, and the damage to the gall-bladder or bile-ducts is only found at the time of operation. Injuries of these organs may, however, occur without damage to the liver, and the gall-bladder is more likely to be affected alone than the bile-ducts; it may be lacerated as the result of a blow over the gall-bladder region, especially if the viscus be distended. These injuries may also occur as a result of stabs or gunshot wounds. Should no immediate operative measures be adopted, the extravasation of bile following the rupture will lead to a plastic peritonitis and the formation of a fluctuating swelling, whilst there will also be jaundice due to absorption of bile from the peritoneum. If left alone, the case may end fatally, either from toxæmia from the absorption of bile, or from septic complications due to contamination of the extravasated material. If the gall-bladder is healthy, the rent in the organ may heal and spontaneous cure may result. If suppuration occurs, the infection may be due either to a septic condition of the bile—as when a diseased and dilated gall-bladder is ruptured—or to organisms that have found their way from the alimentary canal.

TREATMENT.—The abdomen should be opened by the usual incision (see p. 44), the bile sponged away, and the condition of the parts examined.

A limited rupture of the gall-bladder may be closed by a layer of Lembert's sutures, taking up all the coats except the mucous membrane. It is well to insert a drainage tube down to the region of the laceration for a few days in case infection should have occurred before operation. Should there be no signs of suppuration, the tube may be removed on the third day and the abdominal wall brought together by a loose suture inserted, but not tied, at the time of the operation.

In extensive injuries or ruptures of the gall-bladder or cystic duct, the best plan is to remove the gall-bladder (see p. 50).

For a wound of the common duct, the treatment will vary according to its nature. Small vertical or slightly oblique slits need not be sewn up, as they heal well if drainage is provided. Drainage is dealt with in connection with choledochotomy (see p. 53).

Should the duct be torn completely across, an attempt should be made to restore its lumen by suture. Free drainage must also be provided, and some surgeons have recommended that a cholecystenterostomy should be performed at the same time, so as to avoid the risk of a permanent biliary fistula should union of the divided ends of the duct fail to take place. Terrier has suggested that complete rupture of the common duct should be treated by ligature of both ends followed by the performance of cholecystenterostomy. The objection to this procedure is that the

communication established between the gall-bladder and the intestine may lead to septic infection of the bile-passages. We should prefer not to perform this operation at the time the duct is sutured, but, having united the duct and provided free drainage, to wait and see whether union of the common duct occurs. Should this happen, the cure will be complete, while, should union fail and a biliary fistula persist, cholecystenterostomy may be undertaken for its cure as a secondary operation.

CHAPTER III.

ABSCESS, HYDATIDS, AND TUMOURS OF THE LIVER.

ABSCESS.

THE only inflammatory affection of the liver coming under the notice of the surgeon is hepatic abscess ; suppuration in the gall-bladder is dealt with separately (see Chap. IV.).

Suppuration in the liver may take the form either of small multiple abscesses scattered through the organ, or of one, or at most two or three, large circumscribed collections of pus. The small multiple abscesses are practically always associated with pyæmia, either general or portal (suppurative pylephlebitis), and, as surgical measures are of no value in these cases, we need not discuss them further. The larger circumscribed abscesses, however, are of great importance, and may be divided into two groups: namely, those met with in temperate climates and resulting from the various causes enumerated below, and those associated with dysentery—the true tropical abscess.

Suppuration in the liver sometimes, though rarely, occurs without any apparent cause—the so-called ‘idiopathic abscess’—and is due to micro-organisms which probably find entrance by way of the portal vein. In the great majority of cases, however, a primary cause may be traced. Liver abscess may be associated with injuries of the head; here the infective material apparently spreads, not in the form of true emboli, but by the micro-organisms present in the blood, which locate themselves in the liver. Pylephlebitis—which occurs in connection with septic processes, such as appendicitis or ulceration of the bowel affecting the terminals of the portal vein—may give rise to septic emboli and multiple abscesses. Foreign bodies, such as needles that have found their way into the liver, injuries to the organ, or sepsis following injuries to other organs or operations in the portal area—such as those upon the rectum—are well-known causes of the affection; among others may be mentioned parasites in the bile-ducts. Suppuration in the liver may also arise in

connection with gall-stones, the primary affection then being suppuration in the gall-bladder or common bile-duct ; this is dealt with separately (see Chap. IV.). These abscesses are due either to the ordinary pyogenic organisms or to the colon bacillus.

Abscesses due to the above causes may also occur in tropical countries, but in addition there is a form known as '*tropical abscess of the liver*,' which is an affection met with from the 48th degree of north latitude southwards, increasing in frequency farther south ; it occurs sporadically, however, somewhat farther north than this. In this geographical area acute and sub-acute hepatitis are common, and the inflammation of the liver may end in tropical abscess. The disease is essentially associated with true tropical dysentery, although it may come on a considerable time after the dysenteric attack has passed off, and even after all ulceration has healed. It is now held that true tropical dysentery is due to an amoeba, and this parasite has been found in large numbers in the wall of tropical abscesses, if not actually in the pus. The ordinary pyogenic and other kinds of organisms may be present in addition, and the etiology of these abscesses may, therefore, be very complicated. The course of the affection is modified by the other organisms which find entrance simultaneously with, or subsequently to, the amoebæ. It is probable that the amoebæ, when present alone, produce a slow breaking down of the liver without acute suppuration, whereas those cases marked by acute inflammatory symptoms are probably due to a mixed infection, and the acuteness of the attack is, to a certain extent, proportionate to the severity of the infection by other organisms.

Malaria is said by many to play an important part in the causation of the affection, but the abscess is not due to the malarial parasite. By its general effect upon the system and by its local effect upon the liver, malaria may, however, pave the way for the true parasitic invasion which causes tropical abscess.

The great majority of tropical abscesses are single. There may, however, be two, three, or more abscesses in the liver ; when a large number is present the case is probably of an embolic nature. In something like two-thirds of the cases the abscess is situated in the right lobe. As a rule it varies in size, when it comes under surgical observation, from an apple to a child's head ; the average size is that of a fairly large orange. The abscess is usually spherical and contains a fluid which is generally tinged with blood and bile, being yellow, greenish-orange, blood-red, or brown in colour ; discoloured clots and portions of broken-down liver substance are often present. In the acuter forms the abscess contains broken-down hepatic tissue and its wall is pulpy ; in the more chronic ones there is a kind of thickened abscess wall. In bad infective cases the wall of the abscess may be gangrenous, and in these cases recovery is rare, even after free drainage.

Except in cases of embolic origin, the abscess usually commences

deep in the substance of the liver and extends towards the surface. When of any size it generally projects on the convex surface of the right lobe; but it may spread backwards to the area of the liver uncovered by peritoneum, or downwards towards the peritoneal cavity in the neighbourhood of the stomach. When the pus reaches the convex surface of the liver, as it most commonly does, that organ and the diaphragm become adherent, and there may be pleural effusion; in progressive cases the pus finds its way through the diaphragm, causing the under-surface of the lung to become adherent to the upper-surface of the former, and in this way the pus may make its way into the lung and be evacuated through the bronchi. Occasionally, the lung does not become adherent, and the abscess bursts into the pleural cavity and an empyema occurs. When the pus finds its way to the surface of the liver where it is uncovered by peritoneum, the abscess may spread into the abdominal wall. When it points at the lower and front part of the liver, the stomach (in abscess of the left lobe), the duodenum or the colon may become adherent to it and the pus may discharge into the alimentary canal.

The *symptoms* of hepatic abscess are often very obscure. In many cases the abscess occurs in connection with some well-recognised disease, such as dysentery, and its presence may be obscured by this disease and may remain unsuspected for a long time. On the other hand, the liver affection may begin suddenly, and be easily recognised at an early period. The typical symptoms are fever, persistent pain in the right side associated with chilliness or rigors, bulging of the parities, and progressive loss of weight. In some cases of tropical abscess, however, there may not be sufficient symptoms in the early stages to lead to a correct diagnosis, and cases have occurred in which the abscess has only been found *post mortem*, although it must have existed for a long time.

There are one or two points, however, which, quite apart from the acute inflammatory symptoms, point to the occurrence of a liver abscess. There is a peculiar yellowish, earthy coloration of the conjunctivæ, and also of the skin, without true jaundice. The position of the patient is often characteristic; the tendency is to bend towards the right side, to draw up the right thigh, and to contract the right rectus and other muscles on the right side of the abdomen firmly and permanently. Some authors assert that this position is typical of an abscess situated in the concavity of the liver, whereas when it is on the convexity the tendency is said to be to bend towards the left. Alterations in the shape of the liver are also observed. The organ is in any case somewhat larger than normal, and occasionally irregularity in outline may be made out by percussion or by the X-rays. When there is a large abscess on the convexity of the organ there may be diffuse bulging in the lower intercostal spaces, and peritoneal crepitations may be heard over it. Tenderness on pressure may be made out, but fluctuation is seldom elicited unless the abscess has become subcutaneous or penetrates the thoracic cavity, when fluctuation may

occasionally be detected in one of the intercostal spaces. The heart is generally displaced upwards and to the left. Some fever is almost always present in the early stages, but may be absent in the chronic cases ; in the very acute form it is high from the commencement. In the chronic cases it is often irregular, and not very high, while in malarial subjects it is of a more malarial type ; rigors may be present. There is generally a persistent and increasing leucocytosis. When the suppuration is in the left lobe or in the smaller lobes on the concavity, obstinate vomiting is frequently noticed.

From a practical point of view the chief point of importance, after the diagnosis of the presence of an abscess has been made, is its situation. The following points may be mentioned. When the abscess is on the convexity there are symptoms affecting the thoracic organs, such as increased dullness upwards, difficulty or pain on respiration, pain in the right shoulder, projection of the lower ribs and possibly fluctuation. When the abscess is situated in the centre of the organ, there are, in addition to the ordinary inflammatory symptoms, only moderate swelling of the organ and a little jaundice if the abscess is very large. In abscesses situated on the under-surface of the liver there is marked projection of the organ downwards into the abdominal cavity, vomiting, pain in the right flank and hip rather than in the shoulder, and frequently jaundice from pressure on the bile-ducts.

TREATMENT.—The usual surgical rule of evacuating the pus as soon as its presence is determined must be followed, and the question to be considered is how this shall be done.

When the pus has found its way into the abdominal wall, the swelling should be incised, the track traced up to the liver and sufficiently enlarged for free drainage. *When the pus is still confined to the liver* or has spread thence into the lung or the pleural cavity, the great difficulty is the protection of the serous cavity. In a large number of cases in which the abscess follows its usual course towards the convex surface, adhesions with the diaphragm will have formed before the surgeon sees the case, but in others there will be none, and this may be the case also when the abscess is situated on the under-surface, although surrounding structures, such as the omentum or the bowel, may be adherent to its surface ; the condition is closely analogous to the deep-seated forms of appendicitic abscess.

There are three methods of treating an hepatic abscess—namely, incision and drainage, puncture and drainage, and aspiration.

Incision and drainage.—Before making an incision it is always well to ascertain that pus exists by puncturing the liver with a long aspirating needle of wide bore. The spot selected for puncture will depend upon circumstances. When there is distinct bulging below the ribs on the right side and there is reason to believe that the abscess is situated towards the under-surface, the puncture should be made below

the ribs behind ; but in the absence of such definite indication, it should be made through an intercostal space. The usual rule given is that the needle should first be thrust inwards and backwards through the eighth intercostal space in the mid-axillary line and the liver explored in various directions from this spot. If no pus is found, the needle may next be introduced just below the ribs in the nipple line and, failing to find pus there, it may be thrust through the ninth or tenth interspace, below the inferior angle of the scapula. It is always well to have an exhausting-syringe or an aspirator-bottle attached to the needle, and, as soon as the tip of the latter reaches the liver, suction should be established so that pus will flow out directly it is struck ; otherwise the needle may pass through the abscess cavity without drawing off pus.

If pus is not struck when the needle is first thrust in, the latter should be withdrawn until its point is near the surface of the liver, when its direction is altered and it is plunged in once more. If a needle of large bore is used, there is usually a free flow of blood whether pus be struck or not, and this is useful as showing the patency of the instrument ; if nothing comes through, it is probable that the needle has become blocked with liver substance and it is well to force a few drops of normal saline solution through it, so as to clear it. The needle must be allowed to move freely with the liver in respiration, otherwise the liver substance may be unnecessarily torn. Mobility of the exploring needle is an important point, as its absence indicates the presence of adhesions to the diaphragm ; when these are present, the right side of the diaphragm is usually stationary and with it the liver, and consequently the needle.

When pus has been found, the object of the puncture is attained, and the question arises whether the needle should be withdrawn or whether the abscess should be cut down upon with it *in situ* as a guide. When the puncture has been made through an intercostal space, it is better to leave the needle in position ; but, if the puncture has been made through the abdominal wall, this is not necessary, as the laparotomy will expose the surface of the liver and the point of puncture is easily seen. The incision and drainage of the abscess should be done at one sitting. It was formerly the practice to establish adhesions at a first operation, and a few days later to perform a second operation for drainage of the abscess after the adhesions had become established. When, however, the drainage is effected through the abdominal cavity it is quite possible to prevent infection of the peritoneal cavity by packing gauze around the drainage tube for two to three days, even when the pus is virulent. The pleural cavity can also be avoided or safeguarded by appropriate means (see p. 25).

When the abscess has to be opened from the abdomen, a free incision should be made just below the costal margin directly over any prominence that may be present or over the spot at which the needle has localised the pus. When the liver is exposed, the point at which the aspirating

needle has been inserted may be seen, and gauze should be packed all around this spot between the abdominal wall and the surface of the liver, leaving a sufficient area of the latter for free manipulations, just as in evacuating pus through the abdominal cavity. If the puncture is not evident, a fresh exploration may be required to locate the abscess. The liver is then bored through with a pair of sinus forceps until the abscess is reached, and the track is enlarged sufficiently to admit a No. 24 drainage tube. The opening in the liver should be just large enough to grasp the tube, so that pus cannot escape alongside it, and the tube should only have holes at the end where it lies in the abscess cavity. Gauze is now packed around the tube, and the greater part of the abdominal wound is left open, only the ends of the incision being brought together with silkworm-gut. A single abscess treated in this manner does perfectly well in the majority of cases and the cavity closes in a month or six weeks.

When the abscess has to be opened through the thoracic wall, the mid-axillary line should be chosen and the pus located with the aspirating needle as before. In this situation the lowest limit of the pleura is at least two inches above the costal margin; and the pleural cavity may therefore be avoided when the needle is introduced. When the pus has been struck, the needle is left *in situ* and an incision three inches long is made over the rib below the needle and parallel to the long axis of the rib, a portion of the latter is excised, and the dissection carried down until the diaphragm is reached. If the pleura is seen it is pushed upwards.

The diaphragm is now incised with a narrow-bladed knife which should be slipped in alongside the needle. This is done parallel to the direction of the muscular fibres and it is well, in order to shut off the subjacent peritoneal cavity when there are no adhesions, to pack gauze in between the diaphragm and the liver all round the needle; the assistant should press the liver firmly up against the diaphragm meanwhile so as to approximate the two structures. A long pair of dressing-forceps is then thrust alongside the needle until it reaches the abscess cavity, when the blades are expanded sufficiently to admit a drainage tube (*vide supra*).

When the abscess is situated farther back and has to be opened in the line of the posterior border of the scapula, the pleura will necessarily be opened—unless its cavity has been obliterated by adhesions—and means must be taken to close it before the abscess is opened. With this end in view the parietal layer of the pleura should be detached from the thoracic wall, whilst the layer covering the diaphragm is also dissected up and the two edges are united by a continuous suture so as to shut off the pleural cavity; a little gauze may be packed over it for additional protection. After the drainage tube has been inserted, it is well to pack the wound around it with gauze for twenty-four or forty-eight hours. The bleeding, although often free, practically stops as soon as the

drainage tube is inserted, the pressure of the latter causing the arrest of hæmorrhage. The cases usually do quite well.

Puncture and drainage.—This is the method practised by Sir Patrick Manson and others in cases of true tropical abscess; but it is obviously not suited for multiple or multilocular cases. Its object is to drain the abscess with the least possible disturbance or risk of pus escaping alongside it. The skin is incised, and a large trochar and canula is thrust into the liver, in the same way as the aspirating needle is used (see p. 23). When the pus is struck, the trochar is withdrawn and a piece of drainage tube stretched on a probe, so that it will just pass inside

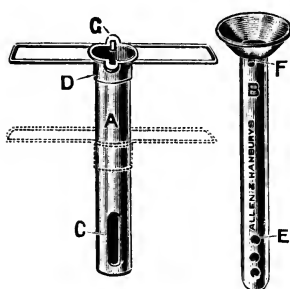


FIG. 3.—MCGAVIN'S WIDE-BORE CANULA FOR DRAINAGE OF LIVER ABSCESSES. A is the canula into which fits the inner tube, B, with a blunt fenestrated end, E, and two small studs, F, so arranged that the studs fit into the small slots, G, in the outer tube and thus keep the openings, E, opposite the long vertical gaps, C, in the latter. D is a movable collar to allow the length of the drainage tube to be regulated.

the canula, is pushed into the abscess cavity and the canula withdrawn leaving the stretched tube *in situ*. As the tube in its stretched state just fits the interior of the canula it also fits the aperture in the liver, and consequently, when the probe is withdrawn and the stretching force relaxed, the liver substance grips the tube tightly and nothing can escape alongside it. Another way of draining these cases is to leave the canula *in situ* to act as a drainage tube, or to fit it with an inner tube with a rounded end that cannot do any damage (see Fig. 3). If the canula is to be used as a drain, it should be fitted with a sliding collar that can be adjusted so as to shorten the tube as the abscess contracts.

Aspiration and injection.—Major Leonard Rogers, I.M.S. (*B.M.J.*, 1902, vol. ii. p. 844), has shown that the amœba is always present in the abscess wall in the true tropical abscess and that the parasite is quickly killed by strong solutions of quinine. He therefore recommends simple aspiration of the abscess followed by the injection of 20 to 30 grains of sulphate of quinine dissolved—with the aid of dilute sulphuric acid—in from 2 to 5 ounces of water; according to the size of the abscess. Simple aspiration has proved successful in many cases, but is not to be relied upon, presumably because of the presence of active amœbæ in the abscess wall; the injection of the quinine solution is meant to destroy these; the method is, of course, useless in the non-amœbic cases. The same surgeon strongly advocates the administrations of large doses of ipecacuanha in the early stages of dysenteric hepatitis, before it is certain that abscess is present. More recently (see *B.M.J.*, Oct. 24, 1908), the same surgeon has advocated a system of continuous siphon drainage combined with daily aspiration and injection of quinine.

HYDATIDS.

The liver is a common seat of hydatid cysts, nearly half of all the cases of echinococcus infection occurring in this viscus. This is explained by the fact that the embryos present in the intestine find their way through its wall, enter the portal vein, and are carried thence to the liver. They occur far more frequently in the right than in the left lobe.

Usually there is only a single cyst and it may attain a large size. There may, however, be many cysts scattered through the liver, varying in size from a small pea to a large orange, or many cysts may be aggregated together and form a large lobulated mass. The cyst is surrounded by a capsule of connective tissue which forms a dense wall, and is developed from the organ or tissue in which the cyst lies. Internal to this connective-tissue capsule lies the true cyst wall, which is a laminated chitinous structure without any cellular or fibrous elements, but which is apparently penetrated by the juices of the body which thus nourish the parasite. The inner surface of the true cyst wall is lined by a delicate parenchymatous layer in which are developed the young heads or scolices, which may number many thousands and may remain for a long time or even permanently connected with this membrane; more frequently, however, they become detached and float in the fluid in the parent cyst leading to the usual appearance of a large cyst full of numerous smaller or 'daughter' cysts. The parent cyst often contains a large amount of fluid, mainly consisting of water with some 2 to 3 per cent. of salts in solution, chiefly chloride of sodium. There is no albumen, but succinate of soda seems to be constantly present in hydatid cysts of the liver, and a substance resembling sugar may also be found; this does not occur in echinococcus cysts elsewhere, so that it may have a certain diagnostic value. Examination of the blood may show eosinophilia and the presence of some substance which fixes complement.

As the cyst grows it destroys that portion of the liver in which it lies, and may ultimately become adherent to some other structure or it may rupture into the peritoneal cavity, the pleura; the intestine, or more rarely, the gall-bladder or the pelvis of the kidney. The larger vessels and the bile-ducts are rarely affected by the pressure, but ascites and jaundice may sometimes occur. Occasionally the cyst dies and shrivels up or remains stationary and becomes calcified; on the other hand, suppuration and hepatic abscess may occur.

In some cases, there are slight constitutional *symptoms*, such as attacks of urticaria—probably from escape of some of the fluid either into a blood-vessel or into the peritoneal cavity. The liver becomes enlarged as the tumour grows, and may be tender. The enlargement may be uniform or irregular according as the cyst is situated deeply

in the substance of the liver or towards one margin. When it projects from the upper surface, an irregular line of dullness may be obtained on percussion. In other cases a distinct tumour may be felt in the abdomen, and then fluctuation can often be made out. Symptoms of pressure on the viscera may also be met with according to the situation and size of the tumour.

Should the cyst burst into the pleural cavity, there is sudden violent pain in the side with great dyspnœa, followed by acute pleurisy, often rapidly fatal. If the cyst is suppurating when it ruptures, there will be an empyema instead of a simple pleurisy. When the cyst bursts into the peritoneum, there is intense and prolonged collapse, and rapid death sometimes follows. If not, violent peritonitis develops, and urticaria may also occur. The fluid from the cyst evidently contains some poisonous material, and not merely the innocuous ingredients that the chemical analysis would seem to imply; this fact is an important contra-indication to treating a case by simple puncture because, quite apart from the possibility of infection by living parasites or by pus, the constant leakage of hydatid fluid into the abdomen may give rise to serious symptoms.

A few words are necessary as to the diagnosis of hydatids of the liver, which is often very difficult—at any rate, in the early stages. A slow growing, irregular enlargement of the liver, which is smooth in outline and fluctuates freely, is practically certain to be of this nature. From hydrops of the gall-bladder it may be distinguished by a recognition of the characters of an enlarged gall-bladder (see p. 38). From pleural effusion it may be distinguished by the length of the history, the insidious onset and the alteration in the level of the dullness during deep inspiration; in hydatids this descends during inspiration, whilst it remains unchanged in pleural effusion. An X-ray examination would show whether the tumour was above or below the diaphragm.

TREATMENT.—The best method of treatment is to lay open the cyst and clear out the 'endo-cyst' and the daughter cysts, either through the abdominal or the thoracic wall. When the operation is done through the abdominal cavity, a free incision is made over the most prominent part of the swelling, the area around the exposed cyst wall is packed with gauze, just as before opening an intra-abdominal abscess, and a large trochar and canula is thrust into the cyst and most of the fluid contents evacuated through it; should the canula get blocked by the daughter cysts, a small quantity of saline solution syringed in will displace them and allow the fluid to flow again. As the cyst wall becomes flaccid, it can often be drawn well up out of the wound. Fresh packing is now substituted and the wall of the cyst is pulled as far out of the abdomen as possible, the patient if necessary being turned slightly over on one side, and then a free incision is made through the cyst wall and the more solid contents are evacuated, their escape being assisted by irrigation. If possible the true cyst wall—the 'endo-cyst'—should be enucleated from

the fibrous envelope surrounding it ; this is usually comparatively easy, as the connection between it and the external envelope is somewhat loose and the finger or a blunt dissector will separate the two. This leaves a cavity which closes quickly.

When the contents of the cyst have been evacuated, a sponge is thrust into the cavity, the gauze packing around is removed, and the opening in the cyst is united by a continuous catgut suture to the cut edges of the peritoneum ; the sponge is then withdrawn, large drainage tubes are introduced into the cavity, and an antiseptic dressing applied. If the 'endo-cyst' has been removed, the cavity closes quickly, the drainage tubes being shortened as it contracts. If, however, a portion of the wall or some of the daughter cysts have been left behind, the cavity must be flushed out from time to time with sterilised salt solution in order to get rid of these structures.

If other cysts are present in the immediate neighbourhood of the primary one they may sometimes be drained through the original opening by burrowing through the liver substance until they are reached. Should the cyst be multilocular, all the septa must be broken down ; should it be suppurating, a similar procedure must be adopted, but extra care must be taken to prevent infection of the abdominal cavity ; in fact, the case must be looked upon as one of abdominal abscess. As a rule, however, adhesions have already formed between the cyst and the abdominal wall in these cases, and the treatment is comparatively simple. It is unnecessary in these cases to pack the cyst afterwards. Complete removal of the cyst with its investing capsule is seldom feasible, and is unnecessary if the 'endo-cyst' is removed. An attempt to remove the fibrous capsule from the liver substance means an extensive operation, accompanied by bleeding which is difficult to arrest, and also by the escape of bile.

When the hydatid cyst grows from the upper and posterior surface of the liver it may project in the subphrenic region and cannot be reached by a laparotomy. The latter method, however, is the best whenever it can be carried out and, even if it should involve the removal of the ends of two or three of the floating ribs, it should be attempted if it appears probable that the cyst can thus be reached through the abdomen. When it is necessary to reach it by the thoracic route, the best plan is to remove a portion of the eighth or ninth rib in the anterior axillary line, to suture the parietal to the diaphragmatic pleura if the pleural cavity has been opened and then to incise the diaphragm in the same way as for an hepatic abscess (see p. 25). If adhesions have formed between the cyst and the under-surface of the diaphragm there will be no further difficulty and the cyst can be laid open freely, its contents evacuated, and large drainage tubes inserted. If, however, adhesions are absent, the steps of the operation will be identical with those for the treatment of the cyst through a laparotomy wound, the edges of the cyst wall being pulled up

through the opening in the diaphragm and attached to the edges of the wound.

When an hydatid of the liver has burst into the abdominal cavity, the proper treatment is immediate laparotomy and flushing of the abdominal cavity with salt solution (see Vol. IV. p. 245), followed by removal of the 'endo-cyst' and drainage of the cavity left.

TUMOURS.

The majority of hepatic tumours are secondary carcinomata and therefore not amenable to surgical treatment. Certain simple tumours of the liver, such as adenomata and angiomas, and also primary malignant growths, particularly those of the gall-bladder and its neighbourhood, may however be removed; Keen ('Annals of Surgery,' 1899, p. 267) has collected seventy-six cases of partial resection of the liver, with a mortality of 14·9 per cent. In the majority of cases the diagnosis is made during a laparotomy performed in order to ascertain the nature of a localised enlargement. Should the physical characters point to an isolated solid tumour in the liver, it is advisable to perform an exploratory laparotomy to ascertain the exact condition of affairs and to excise the growth if possible. Operation is contra-indicated if jaundice is present.

TREATMENT.—It may be possible to excise small tumours situated for instance on the anterior margin of the liver, and to control the hæmorrhage afterwards by bringing the cut surfaces accurately together by deep sutures, as already described for laceration of the organ (see p. 16). As a rule, however, the anatomical conditions negate this, and more elaborate means must be taken to control the hæmorrhage, which is the serious part of the operation. Mayo Robson describes a case in which he brought an isolated growth out of the wound, keeping it in position by sutures and long transfixion-pins and then seared it through with a thermo-cautery after controlling the circulation in it by means of an elastic ligature behind the transfixion-pins. The pins were kept *in situ* for some days, and healing took place by granulation. This method might be followed in the rare event of a similar case presenting itself.

In one case, Keen (*loc. cit.*) removed a carcinomatous left lobe of the liver with a Paquelin cautery, the only trouble met with being during the division of the large veins. He arrested the bleeding temporarily by digital pressure, and finally under-ran the main bleeding points and secured them satisfactorily. The wound was packed with iodoformed gauze, which was removed in the course of two or three days.

For cases such as this a more effectual means of removing portions of the liver without risk of bleeding would probably be found in Nagelschmidt's diathermic apparatus by which the electric discharge is made to penetrate to some distance beyond the cautery-electrode and produces effectual necrosis by actual heat-coagulation.

CHAPTER IV.

THE INFLAMMATORY AFFECTIONS OF THE GALL-BLADDER AND BILE-DUCTS.

THESE may be divided into the inflammatory affections of the gall-bladder (cholecystitis), and those of the bile-ducts (cholangitis).

CHOLECYSTITIS.

This affection is generally acute, and may be simple or suppurative.

SUPPURATIVE CHOLECYSTITIS.

Suppurative cholecystitis is usually associated with the presence of stones in the gall-bladder. In this condition—sometimes called empyema of the gall-bladder when the latter is much dilated—pus forms in the gall-bladder, which may become distended with a mixture of pus, mucus, and bile. In severe cases there may be a gangrenous inflammation or perforation of the wall; the gangrenous form, which is not so common as simple empyema, may accompany typhoid fever, dysentery, or appendicitis.

Empyema of the gall-bladder is generally associated with the impaction of a stone in the neck of the organ or in the cystic duct, the gall-bladder becoming dilated beyond it. There may be little or no constitutional disturbance, unless ulceration of the mucous membrane is present, but the patient usually suffers from anorexia and malaise, with pain referred to the right hepatic region, and some tenderness on palpation over it. When the gall-bladder is distended, it can be felt as a rounded swelling just outside the ninth costal cartilage on the right side. When, however, there is no distension, the true state of matters is often not recognised until the abdomen has been opened.

When the inflammation has lasted for some days, adhesions occur around the gall-bladder which may become fixed to the abdominal wall,

the pylorus, the duodenum, the transverse colon or the omentum, and there is an increase in the general symptoms, with marked pyrexia and great tenderness on pressure, immobility of that part of the abdomen and symptoms of localised peritonitis. When the pus finds its way through the wall of the gall-bladder, the abscess may point in the abdominal wall, either below the costal margin or more commonly in the neighbourhood of the umbilicus. In other cases the abscess may perforate the bowel or may find its way into the subphrenic region.

Hepatic abscess may result from acute cholecystitis. The pus then probably makes its way through the wall of the gall-bladder between it and the liver, and the liver abscess starts from this spot (see Chap. III.).

Acute perforation of the gall-bladder may follow acute suppurative cholecystitis, especially when gall-stones are present. The symptoms are much the same as in the preceding condition, and are mainly those of localised peritonitis, followed suddenly by symptoms of perforation and acute general peritonitis.

Acute gangrenous cholecystitis is not so common, and is seldom diagnosed before operation. It may complicate gall-stones or follow some specific fever. The symptoms are very severe; the entire thickness of the gall-bladder is affected, its walls become gangrenous, and there is intense peritonitis. The proximity of the bowel to the gall-bladder accounts for the fact that some intestinal obstruction usually occurs in these cases which are not infrequently mistaken for cases of acute obstruction or perforative peritonitis.

TREATMENT.—The treatment of suppurative cholecystitis is operative, but the exact condition is frequently not diagnosed before operation, which may be undertaken for the removal of gall-stones.

The treatment for empyema of the gall-bladder is dealt with in connection with gall-stones (see Chap. V.). The treatment of abscess of the liver is described on p. 23. The treatment of perforation of the gall-bladder or acute gangrenous cholecystitis is immediate laparotomy in the right hypochondriac region, removal of any extravasated bile, excision of the gall-bladder if possible, or if not, free incision into it, followed in either case by efficient drainage (see Chap. V.).

NON-SUPPURATIVE CHOLECYSTITIS.

This affection usually occurs as a chronic catarrh of the gall-bladder, and may give rise to symptoms closely simulating those of gall-stones; indeed, it is usually associated with the presence of the latter. It may also occur after typhoid fever or in connection with appendicitis. The gall-bladder contains thick mucus which, in its passage along the cystic duct, gives rise to attacks of colic, often of considerable severity, and it is probable that this condition generally precedes the formation of true gall-stones. As a rule the affection is only diagnosed after operation,

which is undertaken on the assumption that gall-stones are present. Jaundice is rarely met with.

TREATMENT.—Should the condition be diagnosed before operative interference is undertaken, the treatment should be directed to careful regulation of the diet, prescribing proper exercise, and promoting peristaltic action by the administration of suitable laxatives. Occasionally small doses of morphine may be necessary for the attacks of colic.

Should the affection persist in spite of this treatment and cause the patient trouble, the abdomen should be opened and the gall-bladder drained for a few weeks (see p. 48). This will generally cure the condition, the mucous membrane returning to its normal condition. If the cystic duct is blocked, cholecystectomy should be performed.

CHOLANGITIS.

This affection is usually divided into the suppurative and the non-suppurative forms. About the latter we need say nothing, as it is simply the ordinary catarrhal jaundice, which should be treated by medical means. Catarrhal jaundice may also follow a simple catarrhal cholecystitis which spreads from the gall-bladder down the cystic into the common duct.

SUPPURATIVE CHOLANGITIS.

This affection is generally divided into two groups. In the one, the suppuration affects the main ducts and is termed '*suppurative cholangitis*,' whilst in the other the primary branches of the bile-ducts are also affected and the disease is termed '*diffuse cholangitis*.' Both affections are bacterial in origin, and the most frequent factor in their production is undoubtedly the presence of gall-stones. Occasionally foreign bodies, such as an intestinal worm or an hydatid in the bile-passages, may set up the affection, whilst it also occurs in connection with typhoid fever, appendicitis, pyæmia, or dysentery. When any of the latter group of causes is at work, the affection is apt to assume the diffuse form, whilst suppuration limited to the common duct is more frequent when the mischief is set up by a foreign body such as a gall-stone.

Suppurative cholangitis is usually connected with the presence of gall-stones in the common duct, the organisms finding their way up from the bowel. The symptoms are similar to those of the diffuse form, but not so severe. There is high fever with deep and persistent jaundice, which however is variable in degree. The liver is not enlarged and the gall-bladder is not distended. The patient may remain in this condition for a considerable time, a certain amount of the bile finding its way alongside the stone into the duodenum, exacerbations occurring when

the blockage becomes complete. On the other hand, the inflammation may pass on to acute suppurative hepatitis.

Diffuse cholangitis.—This is more common in connection with specific diseases, such as typhoid fever, appendicitis, pyæmia, or dysentery. The inflammation varies much in intensity and may be suppurative or gangrenous and may be followed by most serious complications, such as septicæmia or pyæmia. The symptoms are similar to those of the suppurative form, but rigors are generally present, the liver is markedly enlarged, and the patient rapidly passes into the typhoid state.

TREATMENT.—The treatment of this affection should be mainly directed to the cause, and will consist in removing any gall-stones that have given rise to the affection and securing efficient drainage of the bile-passages (see Chap. V.). Any abscess in the liver should be opened and drained as early as possible (see p. 23). Should no gall-stones be found in the common duct and should the gall-bladder be involved, cholecystostomy with drainage for a few weeks should be carried out. In all cases the common duct should be opened and a drainage tube inserted into it.

CHAPTER V.

GALL-STONES: BILIARY FISTULA.

GALL-STONES.

CALCULI in the gall-bladder or the bile-ducts are rare in young subjects, but quite common after middle age ; they are more frequently met with in women than in men, and it is said that they occur in one out of every six persons over sixty years of age. In a large number of cases the presence of stones gives rise to no symptoms, and the affection is only discovered *post mortem*. The size and number of the stones vary widely ; single stones are usually large and round or oval, whilst multiple ones are smaller and have facets on their surfaces where they rub against one another.

These stones consist either of pure cholesterin, or of this substance combined with a varying amount of bile-salts and bile-pigment—principally bilirubin ; lime-salts are also frequently present, and the stone may vary in consistence from an extremely friable mass to one that it is impossible to break up by pressure between the fingers.

Anything which hinders the free flow of bile from the gall-bladder may predispose to the formation of gall-stones. A sedentary life and irregular meals may be of importance, as the gall-bladder is then not emptied frequently and regularly ; tight lacing, perhaps, has a similar effect. Heredity seems to have some distinct influence. The essential factor is the retardation of the flow of the bile, and when this occurs, organisms, such as the colon bacillus, may find their way into the gall-bladder and set up a cholecystitis of varying intensity. This gives rise to the deposit of cholesterin, which, with precipitated bile-pigment, forms the gall-stone. The actual nucleus is often a mass of inspissated mucus, epithelium, or bile-salts. Organisms, dead and alive, have been found in a large proportion of stones that have been examined from this point of view, among them not infrequently being the typhoid bacillus. Unlike pancreatic calculi, gall-stones are pervious to the X-rays. They are

nearly always formed in the gall-bladder, but occasionally arise in the bile-ducts themselves.

Gall-stones are so often met with in the course of other abdominal operations or at *post-mortem* examinations, without having ever given rise to any symptoms or to any pathological changes in the gall-bladder, that we must conclude that they only cause trouble when they pass into the cystic or common ducts, when they interfere with the escape of bile from the gall-bladder, or when they are associated with cholecystitis (see p. 31). When a stone passes out of the gall-bladder, biliary colic is set up (see p. 37).

When a stone is impacted in one of the ducts, it may give rise to very severe symptoms quite apart from any cholecystitis that it may cause. If it is impacted in the cystic duct, the gall-bladder behind it will dilate and may contain pus, bile, or a thin mucoid fluid; the block usually occurs at the neck of the organ and jaundice is absent. When the stone is impacted in the common duct there is well-marked jaundice, the depth and severity of which will vary with the amount of occlusion that the stone produces. The gall-bladder in these cases is usually not distended, and may even shrink up and almost disappear. The occlusion of the bile-ducts is rarely brought about by the stone entirely filling the duct in which it lies, the final complete blockage being produced by inflammatory swelling of the mucous membrane. When the stone is impacted in the cystic duct occlusion may be complete.

A stone in either of the ducts may pass on into the bowel if small enough; if it is too large to do this, it may eventually ulcerate through the wall of the duct, which becomes adherent to the bowel, and find its way either into the duodenum or the colon, thus giving rise to a fistulous communication between them. The symptoms of biliary colic subside when the gall-stone escapes into the bowel, unless of course other stones are also present.

Various *complications* may occur in connection with gall-stones. Cholecystitis and cholangitis have been already referred to (see Chap. IV.). Adhesion of the gall-bladder or the bile-ducts to surrounding structures is not uncommon, and is often accompanied by stricture or kinking of the pylorus, or intestinal obstruction from kinking of the colon or the duodenum. A rare complication is intestinal obstruction from blockage by a stone that has found its way into the bowel (see Vol. IV. p. 335); the arrest of the stone usually occurs at the ileo-cæcal valve. Suppuration outside the gall-bladder may occur in connection with suppurative cholecystitis or cholangitis; the abscess forms most commonly in the subphrenic region and a fistula about the umbilicus or in the right hypochondrium may result, or the abscess may burst into the peritoneal cavity. Fistulæ may also occur between the gall-bladder or bile-ducts, and the pelvis of the kidney, the bladder, or the vagina. Occasionally the gall-bladder becomes almost obliterated; at other times it may be

strictured at its neck and may be dilated with pus without giving rise to any marked symptoms.

Symptoms of stones in the gall-bladder.—The mere presence of stones in the gall-bladder does not necessarily give rise to noticeable symptoms. In other cases they may interfere with the outflow of bile from the gall-bladder and give rise to hydrops or empyema of the gall-bladder or they may cause cholecystitis (see p. 31).

Symptoms of stones passing along the bile-passages.—The characteristic symptoms to which the passage of gall-stones along the bile-ducts gives rise are grouped under the term '*hepatic colic*.' The chief symptom is pain, which may vary from slight vague discomfort, usually ascribed to dyspepsia, to excruciating colicky pain requiring morphine for its relief. The pain usually comes on suddenly after a meal or after some exertion and is paroxysmal in nature, but in the intermissions of the severe pain a dull aching remains. The pain is usually referred to the right hypochondrium, but often shoots up into the right shoulder, and in bad cases is referred to the whole of the right half of the abdomen. Vomiting frequently occurs. There may be no jaundice unless the stone has passed into the common duct, in which case jaundice generally appears after a few hours.

Symptoms of stones impacted in the bile-ducts.—When the stone lies in the cystic duct, jaundice is exceptional; the only constant symptoms are dilatation of the gall-bladder (which, however, cannot always be felt), uneasiness referred to the right hypochondrium, and dyspepsia. If, however, cholecystitis is present, as is frequently the case, there may be pain and tenderness, accompanied by fever and the presence of a definite tumour in the gall-bladder region. Jaundice may also occur under these conditions owing to the spread of the inflammation from the cystic to the common duct.

When the stone lies in the common duct, the pain and tenderness are more marked and there is always jaundice, which is often profound, but which varies in intensity from time to time and only passes off completely when the stone escapes from the duct. There is usually anorexia, accompanied by constipation, and vomiting may occur at first. If the impaction lasts for any length of time, there will be marked cachexia and cholæmia. Even a large stone impacted in the common duct, however, may not always give rise to severe symptoms; there may be only a little occasional colic and some slight jaundice, as the duct may dilate rapidly and the bile may be able to pass by the obstruction in considerable quantities.

Symptoms accompanying complications.—The chief complications of gall-stones are cholecystitis, cholangitis, the formation of adhesions in the neighbourhood of the gall-bladder or bile-ducts, and the occurrence of intestinal obstruction either from the presence of these adhesions or from the impaction of a gall-stone in the bowel. Cholecystitis and cholangitis

are discussed in Chap. IV. Adhesions in the neighbourhood of the gall-bladder do not necessarily give rise to trouble. Their presence, however, may be suspected when there is a history of attacks of biliary colic, and when there are persistent symptoms—such as pain after food, flatulence, and constipation. It is not always possible to distinguish between gall-stones and adhesions which compress the bile-duct, and cases are occasionally diagnosed and operated upon as gall-stones in which only adhesions are found. The symptoms of intestinal obstruction from gall-stones are described in Vol. IV.

Clinical signs.—*Palpation of the gall-bladder* affords valuable information under certain circumstances; in others, however, it may give no indication whatever. It is carried out as follows. The patient lies upon the back on a couch with the knees flexed and the pelvis and thorax slightly raised so as to relax the abdominal muscles, and the surgeon stands on the right side. The patient breathes regularly and deeply, and the surgeon places the left hand flat upon the right lumbar region posteriorly, whilst the right hand is placed over the abdominal wall in front, immediately below the ninth and tenth right costal cartilages, and gently and slowly pressed inwards as the patient breathes; the left hand meanwhile pushes up the liver from behind and makes it prominent. In this way the presence of tenderness on pressure may be elicited, the outline of a tumour ascertained, and the amount of its movement on respiration made out.

An enlarged gall-bladder forms a somewhat pyriform swelling opposite the ninth costal cartilage just outside the edge of the right rectus, with its long axis directed obliquely downwards and inwards towards the umbilicus. It may be globular or elongated and sausage-shaped, it blends with the liver dullness above, and when there are no adhesions is freely movable from side to side, but always returns to its place, in which respect it differs from a movable right kidney with which it is not infrequently confounded. When the swelling moves downwards on deep inspiration it cannot be fixed in that position between the two hands during expiration as a movable kidney or a tumour of the bowel can; it invariably slips upwards again. In rare cases gall-stones can be actually felt grating on one another.

Physical examination of an enlarged gall-bladder should not go beyond palpation. Puncture should never be resorted to, as the wall of the organ is often extremely thin, and leakage of septic bile or pus from an infected gall-bladder may occur and lead to fatal peritonitis.

When no tumour can be felt in the region of the gall-bladder and there is no typical biliary colic, the surgeon must always think of a renal or alimentary origin for the pain of which the patient complains, and the past history must be carefully inquired into; a history of past attacks of biliary colic followed by jaundice and the passage of gall-stones may throw valuable light upon the nature of the case.

When no tumour can be felt and no tenderness can be elicited by palpation with the patient in the recumbent position, he should be made to sit up, the surgeon's hand should be pressed deeply inwards below the normal situation of the gall-bladder, and the patient told to take several deep breaths. On deep inspiration the gall-bladder is pushed down against the surgeon's hand, and pain is often elicited towards the end of the inspiration.

The relation between gall-stones and jaundice.—Jaundice produced by gall-stones may be due to two distinct causes. On the one hand it may be caused by an inflammatory swelling of the mucous membrane of the common duct, set up by the passage of the gall-stones. This form is usually mild and transitory. The other form is the deep and persistent variety, which occurs when the common duct is blocked. Blockage of this kind is usually due to the impaction of a biliary calculus, but may also arise from the pressure exerted by tumours or from inflammatory affections in the neighbourhood. At the same time it must be remembered that impaction of a gall-stone in the common duct is not necessarily accompanied by persistent or profound jaundice, as the duct may dilate above the stone and the latter may then merely exert a sort of ball-valve action and allow bile to pass through the duct into the duodenum from time to time. When the stone is faceted, bile may pass in small quantities by the side of the stone even if it is impacted. It is probable that complete occlusion is produced by the inflammatory swelling of the mucous membrane around the stone. Jaundice due to an impacted biliary calculus thus differs in some respects from that due to malignant disease, and it is important to bear this in mind in considering the indications for operation. Jaundice due to malignant disease is intense and persistent, and does not vary in intensity except to become deeper.

In bad cases of obstructive jaundice the presence of bile in the blood gives rise to defective coagulating power, and this is a point of great practical importance as it forms a distinct contra-indication to haphazard exploratory operations in cases of obstructive jaundice due to malignant disease, especially of the pancreas. If the cause of the obstruction can be relieved by operation, this want of coagulability of the blood soon passes off; but when this has been impossible, patients have bled to death, and therefore no exploratory operation should be undertaken in cases with profound jaundice, unless there is a fair chance of relieving the obstruction.

The *prognosis* is always doubtful, even in those who suffer from occasional attacks of mild colic, and there is no possibility of predicting the course that any given case will run, as a series of mild attacks may be followed by severe complications, while, on the other hand, severe attacks may end in permanent cure as the result of the stone giving rise to a communication between the alimentary canal

and the gall-bladder or bile-duct. The tendency to spontaneous cure is, however, slight; as a rule the best that can be hoped for from palliative measures is a long period of quiescence. The prognosis is much improved by early operation, and there is then little danger accompanying operative interference; this cannot be said of the cases operated upon late in the disease, especially when cholangitis or cholecystitis is present.

We may divide the cases met with in practice into six large groups:—

1. The gall-bladder contains gall-stones, but the cystic duct is patent.

2. The presence of stones in the gall-bladder is complicated by the passage of a gall-stone along the cystic duct.

3. The cystic duct is occluded either by a stone impacted in it or by inflammatory adhesions resulting from the antecedent passage of a stone. This may lead to a *hydrops of the gall-bladder*, in which the organ contains a glairy, viscid, mucoid fluid; or to an *empyema of the gall-bladder* in which the contents are purulent.

4. A stone is passing along the common duct on its way to the duodenum.

5. A stone is permanently impacted in the common duct.

6. Cases presenting many of the symptoms of gall-stones, in which, when the abdomen has been opened, no gall-stones are found either in the gall-bladder or the bile-ducts, but instead extensive adhesions external to these structures or cholecystitis or cholangitis may be present.

TREATMENT.—The first point for decision is whether operative interference is required. The following are our own views as to the indications for operation and the most suitable operative procedures:—

Whilst palliative measures may suffice for mild cases, it is improbable that they can ever produce more than a prolonged latent period; they are therefore not curative, and a blind adherence to them may end in the surgeon missing the most favourable time for successful operative interference. It is so difficult to gauge the extent of the affection without opening the abdomen that no reliable criteria are available as to which cases are likely to be benefited by palliative measures. In favour of operation is the fact that it removes all the stones and drains the gall-bladder, whereby any cholecystitis is cured. At the same time there is no certainty that fresh stones will not form after cholecystostomy; and even after cholecystectomy it is possible for stones to form in the hepatic duct; both events, however, are exceptional. Another point of practical importance is that in early cases there is no risk of that serious bleeding which is met with so often in those who are the subject of persistent and profound jaundice.

Palliative.—Palliative measures may be employed:—

1. When there are slight attacks of jaundice occurring at intervals and accompanied by the passage of small gall-stones, provided that the patient's health returns to the normal between the attacks and remains good until the next attack occurs.

2. Cases of impaction of a stone in the common or cystic duct seen immediately after its occurrence. In these cases it is well to allow time to elapse in order to see whether the stone will pass into the duodenum or not. If the stone remains impacted in the duct after trial of medical measures for a fortnight or so, the case becomes one of chronic impaction and demands operation. Should, however, fever or local pain and tenderness occur in the course of an attack of this kind, operation should be undertaken without delay.

3. Very old and debilitated subjects with non-impacted gall-stones will probably live longer if treated by palliative measures, as operation may prove fatal.

4. When there is a doubt as to whether a case of profound and persistent jaundice is due to blockage of the common duct by a stone or to its occlusion by malignant disease, palliative measures should be tried for a few weeks in order to allow sufficient time to elapse for the diagnosis to be made certain. Should the case be one of gall-stones, there will be comparatively little change in the patient's condition in that time; should the mischief be due to malignant disease, the patient will go rapidly downhill, a tumour will probably become evident, and possibly secondary deposits will be found elsewhere. On the other hand, if an attempt is made to clear up the diagnosis immediately by an exploratory laparotomy, the patient may no doubt be cured if there is a stone impacted in the common duct; but should the case turn out to be malignant disease, the patient's life will probably be materially shortened. When an intensely jaundiced patient has also subcutaneous hæmorrhages resembling purpura hæmorrhagica, it will be better not to operate, as fatal bleeding is almost certain to result. It is difficult to ascertain beforehand the danger of this complication, as tests of the coagulating power of the blood are unreliable.

Palliative treatment mainly resolves itself into the treatment of an attack of biliary colic, which is best met by giving a full dose of opium and applying hot fomentations or placing the patient in a hot bath if that is possible. After immersion in the bath for ten minutes or so the patient should be put to bed and hot fomentations applied all over the abdomen, especially to the hepatic region; leeches to the right hypochondrium are said to give relief when there is tenderness on pressure over that area. As a rule this treatment will suffice for the relief of symptoms of moderate severity, but, when the attack is very acute, repeated full doses of morphine are called for, and the best plan is to administer it subcutaneously, as the patient is often sick and cannot retain the drug by the

mouth. When there is no vomiting, two grains of opium may be given by the mouth, combined with half a grain of extract of belladonna, and repeated later if necessary.

In the intervals between the attacks of colic the most important point in the treatment is to regulate the diet, which should be easily digestible and contain only a limited amount of nitrogenous material. When the patient suffers from jaundice it is advisable that fatty articles of diet should be very sparingly partaken of, as the absorption of fatty food from the intestines under these circumstances takes place very slowly.

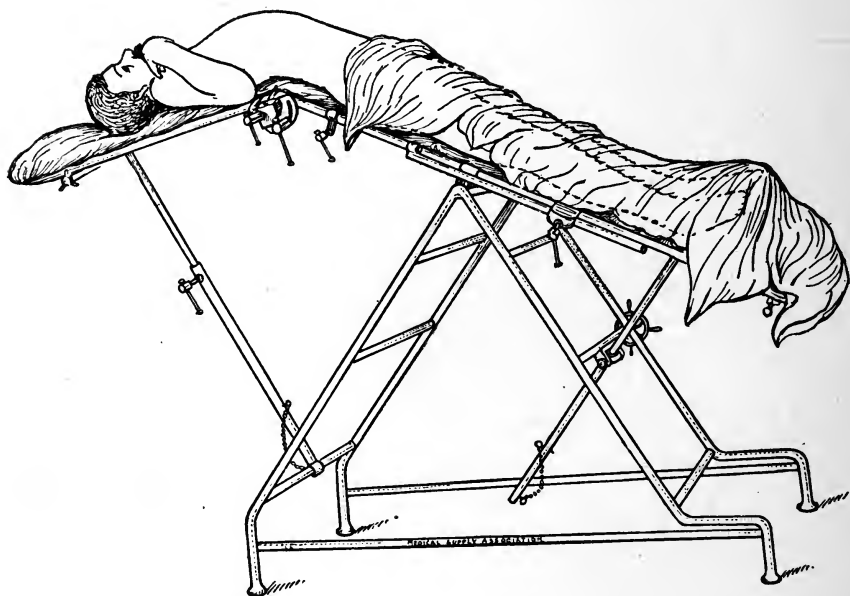


FIG. 4.—THE HEPATIC REGION, ELEVATED BY MEANS OF A SPECIAL POSITION OF THE OPERATING-TABLE. Many of the modern operating-tables provide for this position. (Mayo Robson, in *A System of Operative Surgery*, edited by F. F. Burghard.)

Saline aperients are generally required, and proper exercise must be provided for.

Operative.—Operative measures should be employed in the following cases: (1) In acute suppurative cholecystitis. (2) In chronic impaction of a stone, either in the cystic or the common duct. (3) In cases of severe recurrent colic, when the attacks demand large doses of morphine, and are so frequent that there is a risk of the patient becoming the subject of the morphine habit. (4) In cases accompanied by enlargement of the gall-bladder or the liver, or by persistent jaundice. (5) In cases accompanied by symptoms of adhesion of the gall-bladder to the stomach, pylorus, or colon. (6) In cases with

symptoms of suppurative cholangitis or perforation of the gall-bladder or bile-ducts.

An operation for gall-stones may vary from a simple procedure to one of exceeding difficulty without there being any indication beforehand as to which it will turn out to be. It is important that the patient should be directly under the eye of the surgeon for the first week at least after the operation, as many points may arise in the after-treatment with which he can deal best.

The preliminaries for the operation are similar to those for laparotomy (see Vol. IV. p. 208), and every precaution must be taken against shock, as, although the operation is neither prolonged nor severe in ordinary cases,

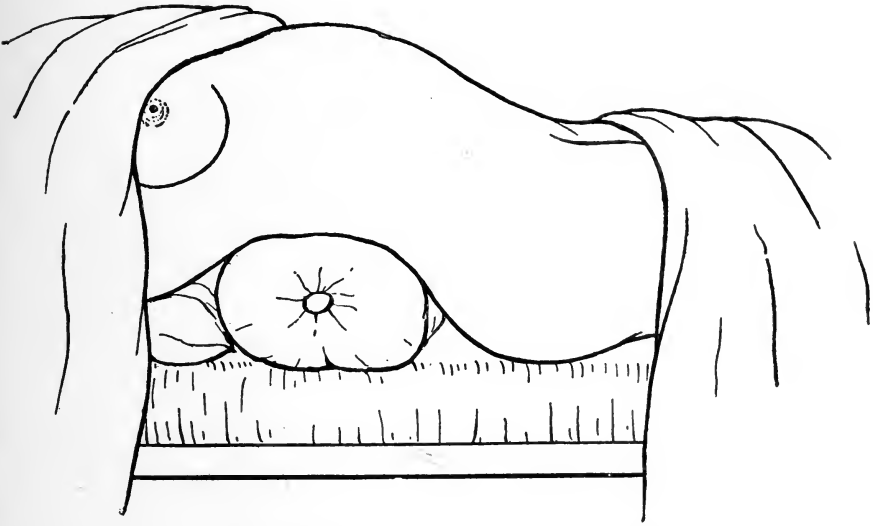


FIG. 5.—A METHOD OF MAKING THE BILE-DUCTS ACCESSIBLE. This applies to an ordinary operating-table. (Mayo Robson, in *A System of Operative Surgery*, edited by F. F. Burghard.)

a bad case of stone impacted in the common duct may mean a most tedious and difficult operation. The bowels should be thoroughly evacuated before the operation. If chronic jaundice is present, it will be well to give two doses of 30 grains each of lactate of calcium the day before the operation, and to repeat the dose by the rectum after the operation if the coagulating power of the blood is feeble.

The position of the patient on the operating-table is important (see Fig. 4). The bile-passages may be rendered accessible by placing a sand-bag about four inches deep beneath the floating ribs on an ordinary table. This throws the liver well up and at the same time allows the intestines to fall away from it downwards towards the pelvis (see Fig. 5). A good light upon the operation area is indispensable. All swabs, sponges,

and abdominal cloths must be counted before and after the operation, and any that have been used for absorbing bile should not be used when the abdominal wall is being repaired.

Two *incisions* are employed : the most common being a vertical one passing downwards through the fibres of the right rectus about an inch to the right of the middle line (see Fig. 6). It should commence about the level of the junction of the seventh with the eighth costal cartilage, and its length will vary with the condition of affairs for which the operation is required. When the case is one of calculi in the gall-bladder, it need not be more than three inches long

if the patient is not very fat, but if the stones are in the common duct, it will have to extend below the umbilicus and, in addition, the upper end may be prolonged towards the xiphoid cartilage ; in very fat subjects it may be necessary to carry it outwards at its lower end.

Another incision which has some advantages, and which is frequently used, is an oblique one parallel to and about an inch below the lower border of the ribs, commencing over the middle of the rectus in front and extending outwards and backwards for four or five inches. The rectus is not divided in the first instance, but that may become necessary in the case of stones impacted in the common duct ; in place of this a short vertical incision may be added to the oblique one.

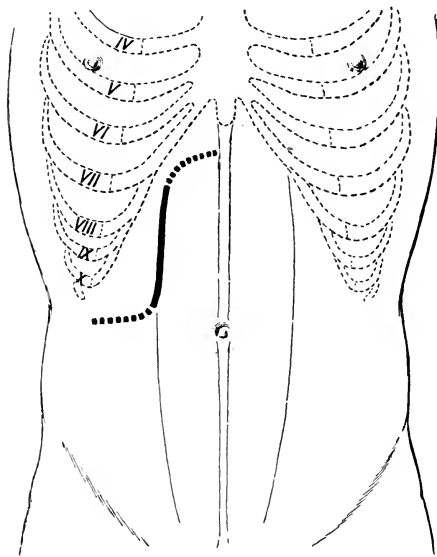


FIG. 6.—BEVAN'S INCISION FOR EXPOSURE OF THE COMMON DUCT. The thick line is the incision that suffices in spare subjects or for gall-bladder operations. The dotted lines show the direction in which the incision is enlarged in order to expose the common duct. It is not often necessary to make use of the lower dotted incision. (*Annals of Surgery.*)

When there is jaundice, all bleeding points should be ligatured before the peritoneum is opened. If the gall-bladder is not adherent to the anterior abdominal wall, the free edge of the liver is pulled well upwards under the ribs, and is kept in position by an assistant who grasps it outside an abdominal cloth. The surgeon then examines for adhesions and notes the condition of the gall-bladder. The cystic duct is next examined, both for adhesions and for the presence of a stone. Finally, before deciding on the further steps of the operation, the common bile-duct should be examined, even when there is no jaundice ; the duct is generally easily found as it is only necessary to trace the cystic to its junction with

the hepatic duct. When, however, there are numerous adhesions they may obscure the position of the duct; the best plan then is to hook the forefinger into the foramen of Winslow, as the common duct lies in its anterior wall. Finally, the pylorus, the duodenum, and the pancreas should all be examined to see whether there are adhesions between them and the bile-ducts or whether chronic pancreatitis is present.

When the gall-bladder is adherent to the abdominal wall the incision through the peritoneum will run on the inner side of the adherent organ, and the condition of the ducts is then ascertained by palpation. If a careful examination shows the presence of a stone in the common duct this is removed first (see p. 52) and the gall-bladder attended to afterwards. Should none be found, the peritoneum is accurately sutured so as to prevent the possibility of infection, and the gall-bladder is then laid open if necessary, after withdrawing the bulk of its contents with a small trochar and canula, and any stones in its interior are removed (*vide infra*). Finally, the adherent gall-bladder is drained as in cholecystostomy (see p. 47).

When there is hydrops or empyema of the gall-bladder the condition points to complete occlusion of the cystic duct, and the only certain method of cure is removal

of the gall-bladder, as drainage alone may give rise to a permanent fistula. In some cases a stone may be found blocking the duct and should be removed through an incision in the fundus, the gall-bladder being drained so as to allow the fistula to close spontaneously. In many cases, however, it does not heal because stricture of the duct may follow impaction of a stone in it even after the latter has been removed. Hence cholecystectomy (see p. 50) is the best operation in these cases if it can be performed.

When there are stones in the gall-bladder but none in the ducts. There are four methods by which the condition of affairs may be dealt with—namely: cholecystotomy, cholecystostomy, cholecystectomy, and cholecystenterostomy.

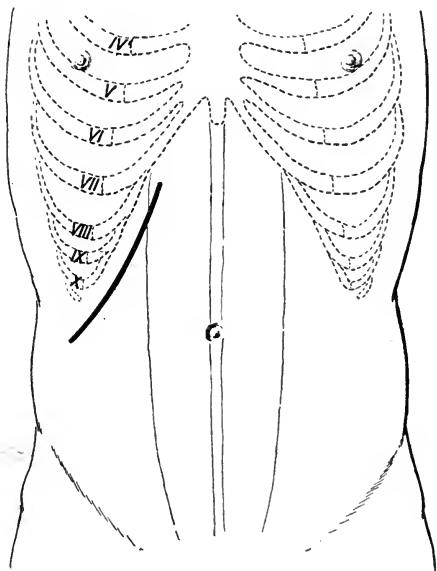


FIG. 7.—THE OBLIQUE OR SUB-COSTAL INCISION FOR OPERATIONS UPON THE BILE-PASSAGES. The incision should be at least an inch below the costal margin.

Cholecystotomy.—After the abdomen has been opened (see p. 44) and the condition of the parts ascertained, abdominal cloths are packed round the gall-bladder, and the fundus is drawn well up into or out of the wound; if the organ is distended, it is well to draw off the bulk of the fluid with a trochar and canula so as to prevent the bile from flooding the wound when the incision is made into the gall-bladder. The fundus

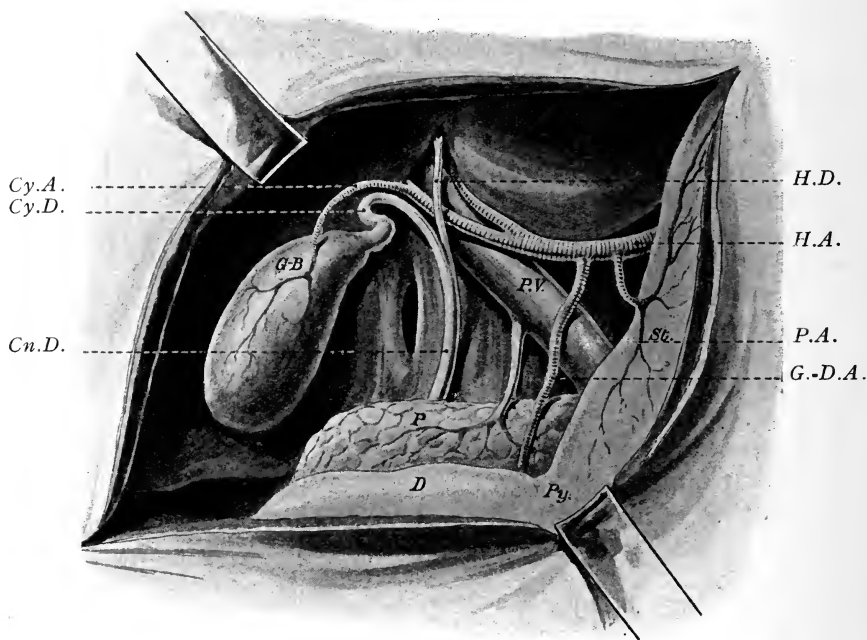


FIG. 8.—THE STRUCTURES SEEN IN THE OPERATIONS UPON THE BILE-PASSAGES. The anterior layer of the gastro-hepatic omentum has been removed.

Cy.A.	Cystic artery.	H.D.	Hepatic duct.	Cy.D.	Cystic duct.
Cn.D.	Common duct.	H.A.	Hepatic artery.	P.A.	Pyloric artery.
G.-D.A.	Gastro-duodenal artery.	G.-B.	Gall-bladder.	P.	Pancreas.
D.	Duodenum.	St.	Stomach.	P.V.	Portal vein.
Py.	Pylorus.				

(Modified from Bevan, *Annals of Surgery*.)

is now laid open and the cut edges of the incision are seized in catch-forceps, and any bile that escapes is rapidly mopped up. It is well to place a receptacle under the gall-bladder before opening it so as to catch the bile and the stones. A medicine-glass does very well, but the best arrangement is Mayo's spoon (see Fig. 9). The stones are removed with forceps or a scoop (see Fig. 10), and the interior of the gall-bladder is explored with the finger, in order to make sure that all the stones have been removed. The opening in the fundus is now covered with a piece of wet gauze, the surgeon cleanses his hands afresh and palpates the duct from

the outside in order to see whether any stone has been pushed into the cystic duct; it is well also to try to pass a probe along the cystic duct so as to determine its patency, guiding the instrument by the finger outside. If the duct is found to be patent, the incision in the gall-bladder is closed by a row of Lembert's sutures and the organ dropped back into the abdomen, which is sewn up as after an ordinary laparotomy. In case leakage should occur it is well, however, to introduce a drainage tube through the abdominal wound down to the incision in the gall-bladder so that, should re-accumulation occur and the incision in the gall-bladder



FIG. 9.—MAYO'S GALL-BLADDER TRAY. The gall-bladder is opened over the spoon-like end of the instrument, and the bile and gall-stones are received into it.

give way, the adhesions will prevent the bile from passing into the abdominal cavity and it will be conducted outwards through the abdominal wound. This drainage tube is dispensed with in about a week's time.

This method is only suitable for a few cases, because some inflammatory complication which requires drainage, such as cholecystitis, is usually present. Moreover, suture is only possible when the walls of the gall-bladder are fairly thick; when thin, as they often are, the sutures will penetrate its cavity. Apart from this also it is very difficult to be certain that the bile-passages are clear of stones. The tortuosity of the cystic



FIG. 10.—GALL-STONE SCOOP. The instrument is made of soft metal, and one end is a probe-director.

duct renders it easy for a stone to escape detection, especially if there are adhesions in the neighbourhood, and the surgeon may erroneously conclude that he has removed all the stones; if then he closes the gall-bladder without drainage, fresh accumulation will occur, the stitches may give way, and there will be extravasation of bile into the abdominal cavity, and possibly fatal peritonitis.

Cholecystostomy.—When the gall-bladder is not removed, it is well to drain it temporarily, especially when there is an inflammatory condition of the mucous membrane, for the cure of which drainage is necessary. There are several ways of establishing drainage, but perhaps the simplest is—after the stones have been removed—to insert a circular purse-string

suture around the incision and some distance from it, and then to introduce a drainage tube of glass or india-rubber, invert the wall of the gall-bladder beyond the suture, and tie it tightly around the tube (see Fig. 11). This suture holds long enough for adhesions to form ;

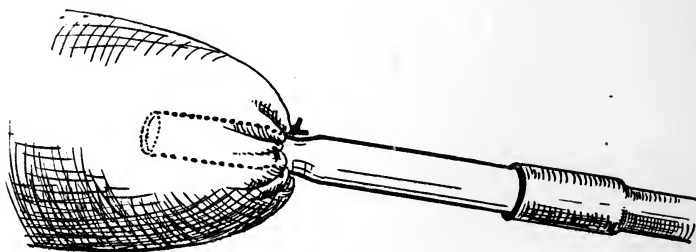


FIG. 11.—CHOLECYSTOSTOMY. Drainage by means of a glass tube secured by a purse-string suture. This is the simplest and quickest way of ensuring a water-tight drain. The absorbable catgut suture should be stout and tied as tightly as possible round the waist of the glass tube.

when it cuts its way out and the tube becomes loose, a track will be established through which bile may flow without any risk of passing into the abdominal cavity. It is well to leave the ends of the suture long so

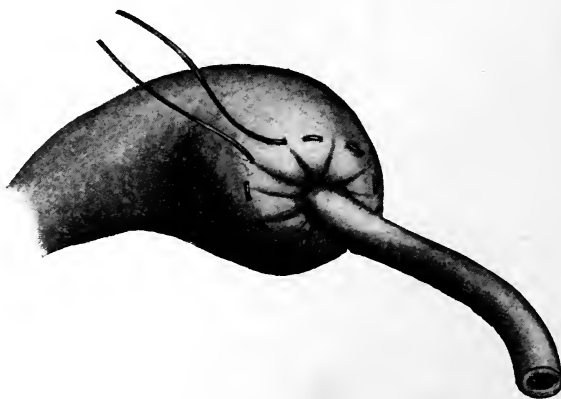


FIG. 12.—CHOLECYSTOSTOMY. Drainage by Kader's method. The stout rubber tube is first tied in by a single stitch. Then the purse-string suture is inserted as shown. As this is tightened and tied, the tube is pushed in so as to form a funnel-shaped depression ; when the suture is tied, this gives rise to the characteristic nipple-like projection of the wall of the gall-bladder inwards.

as to insure its subsequent removal. The drainage tube should be long and pass through the dressings, and its end is inserted into a bottle which is attached to the bandage on one side of the patient, and into this the bile is drained direct without soiling the dressings, at any rate for the

first few days. The bottle should contain some antiseptic solution, and the end of the tube should be immersed in this so as to prevent sepsis spreading backwards along the tube. The drainage tube should have specially thick walls so that the suture can be tied tightly around it and thus prevent leakage of bile alongside it. The material for suture should be ordinary absorbable catgut. This tube will often prevent leakage for at least ten days. Unless there is some permanent obstruction in the bile-passages, the fistula readily closes after the drainage tube has been left out.

The method of effecting temporary drainage of the gall-bladder without risk of infecting the peritoneum or soiling the dressings shown in Fig. 12 is an adaptation of Kader's method of performing gastrostomy, and has the additional advantage that the flow of bile ceases as soon as the tube is removed; another method that requires a special apparatus, but is very effectual in preventing the soiling of the dressings with bile, which is often such an annoyance in these cases, is shown in Fig. 13.

After the drainage of the gall-bladder has been arranged for, the remainder of the wound is stitched up by a series of through-and-through stitches taking up the whole thickness of the abdominal wall; the skin may be united by a continuous suture. Buried sutures should not be employed, as the bile in these cases is seldom aseptic; and they may become infected; in that case the wound will not heal until they are extruded.

The *after-treatment* is simple. Any shock is treated, and the general treatment for abdominal cases is employed (see Vol. IV. p. 209).

The drainage of the gall-bladder is maintained for ten days or more,

v.

E

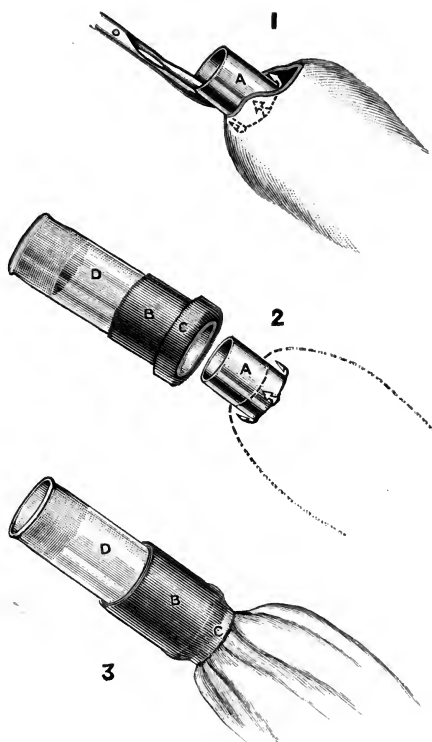


FIG. 13.—CHOLECYSTOSTOMY. *Drainage without suturing in a tube.* The apparatus figured above is made for us by Mr. C. A. Hoefftcke, and is an adaptation of Collier's intestinal drainage apparatus (see Vol. IV. p. 383). The metal tube, A, is provided with a crown of hooks, which engage in the mucous membrane of the gall-bladder. The cuff, C, of the rubber tube, B, is turned down over it when it is in position and grips its lower edge firmly, making a water-tight drain through the tube D. The entire apparatus comes away in a week or ten days. The figures 1, 2, 3 denote the stages of the introduction of the tube.

according to the necessities of the case. The tube is removed when the amount of bile is getting less and the rest of the wound has healed. If gauze has been packed in it may be removed at the end of three days, after which the drainage tube alone will suffice. When the tube is left out the fistula is allowed to heal. Strict asepsis must be maintained not only at the operation, but throughout the after-treatment, as a suppurating gall-bladder is a troublesome complication. Should the fistula not heal in two or three months the case becomes one of biliary fistula, the treatment of which is discussed on p. 58.

Cholecystectomy.—Excision of the gall-bladder, together with the stones contained in it, may be called for in some of these cases, but care must be taken to remove any obstruction in the common duct in the first instance, whether from gall-stones or adhesions. Any adhesions between the gall-bladder and the surrounding structures are divided and then the gall-bladder is separated from the liver; this separation may be begun either at the neck or at the fundus. It will generally be best to commence at the fundus and proceed from before backwards, stripping the gall-bladder up with the finger or a blunt dissector; but if there are many adhesions binding down the fundus, the cystic duct may be isolated first, clamped and divided between two pairs of forceps, and the gall-bladder then raised from the liver from behind forwards. In either method the cystic duct should be clamped in the first instance in order to prevent stones being pushed into it during the manipulations necessary to separate the gall-bladder from the liver. As much of the peritoneum as possible should be dissected off the sides of the gall-bladder and left behind in order that it may be laid down afterwards over the raw surface, so as to minimise the adhesion of the intestines or omentum to the under-surface of the liver. If this is done carefully it is often possible to cover all the raw area with peritoneum.

The chief sources of bleeding are the raw surface of the liver and the cystic artery. The first is only a slight oozing, if the gall-bladder has been carefully separated from the liver. The cystic artery lies between the liver and the cystic duct, and it is usually possible to separate it from the duct and secure it separately before ligaturing the latter. If this can be done the ligature is less likely to slip.

If the open end of the divided cystic duct is sufficiently large and the parts are accessible, it may be treated in the same way as the stump of an appendix (see Vol. IV. p. 417), or it may be covered by a flap of peritoneum from the neighbourhood; in any case it is well to cauterise the cut end with undiluted carbolic acid. It is always well to insert a small drainage tube for two or three days in order to allow the escape of any bile which may come from the raw surface of the liver, and in case septic infection should occur.

Choice of operation.—In the majority of cases the choice lies between

cholecystostomy and cholecystectomy. The advantage of cholecystectomy is that it not only gets rid of the stones which are present, but also removes the inflamed gall-bladder; and it is improbable that the patient will ever be troubled with gall-stones again, as they very rarely develop in the hepatic ducts; the convalescence is also much shortened, most patients being well in three weeks. The surgeon must, however, be certain that there are no stones in the common duct. A stone in the cystic duct is not a contra-indication to the operation, as removal of the cystic duct may be combined with the cholecystectomy. There is much divergence of opinion on the question of cholecystostomy *versus* cholecystectomy even among the writers of this volume, some preferring cholecystectomy whenever it can be done, others limiting its use to cases in which the gall-bladder is small and shrunk. The radical operation is more severe than cholecystostomy and is not advisable in feeble and old patients, but it is being more generally employed than it was.

Cholecystostomy should be employed when there are extensive adhesions of the gall-bladder, when the patient is too feeble to stand extirpation, and when there is any doubt as to whether the common duct is patent.

The 'ideal' operation, or cholecystotomy, is only available in a small number of cases in which there is little or no cholecystitis and the walls of the gall-bladder are moderately thick, and when it is certain that there are no stones either in the cystic or the common duct.

When a stone is impacted in the cystic duct.—After the stones in the gall-bladder have been removed, fine forceps or a scoop should be introduced through the opening in the fundus and guided to the cystic duct by the finger passed in through the abdominal wound and palpating the duct from the outside, the abdominal cavity being carefully packed off so as to avoid all chance of contamination by the bile. Attempts are then made to guide the forceps or the scoop along the duct and to withdraw the stone; these attempts may sometimes be aided by pushing the stone up towards the neck of the gall-bladder. If this fails, an incision may be made directly over the stone towards the hepatic aspect of the duct so as to secure adhesions between the incision and the liver after removal of the stone, and not between the duct and the stomach. The cut edges of the duct are united by Lembert sutures of fine catgut, and the opening in the fundus is drained (see p. 48).

In these cases, however, it is better to remove the gall-bladder and the cystic duct together with the stones in them, unless the patient is old and very feeble. Cholecystectomy has the further advantage here that no biliary fistula is likely to follow, whereas this may happen after removal of a stone from the cystic duct, as the inflammatory condition produced by the impaction of the stone may end in a cicatricial stricture of the duct, which will give rise to a permanent fistula. Moreover, it is more difficult to suture an incision in the cystic duct than to deal with its divided end.

When a stone is impacted in the common duct.—A stone in the common duct should be removed by incising the common duct directly over it—choledochotomy.

Choledochotomy.—The laparotomy incision must be long, especially in fat subjects, in order to give proper access to the duct ; if the vertical incision has been employed, it is well to add a short transverse cut or to curve its upper end inwards to the middle line (see Fig. 5). As the shock may be considerable, the most energetic measures should be taken to combat it (see Vol. IV. p. 209). The liver must be made prominent by a sand-bag under the lower ribs (see p. 43), and if the shoulders are also raised the liver gravitates downwards and the duct becomes more accessible.

After the abdomen has been opened, the parts must be displaced so as to give a good view of the common duct ; the best way to effect this is to pull up the anterior edge of the liver, rotating it upon itself around its transverse axis, and after enveloping it in gauze, to give it to an assistant to hold. The common duct is thus brought about an inch nearer to the surface than its normal position. The intestines fall downwards by their own weight ; they may be kept out of the way by abdominal cloths, which must also be arranged so as to protect the whole area. Packing should be thrust well into the foramen of Winslow.

The next point is to trace the cystic duct down to the common duct, separating adhesions to facilitate the identification of the latter structure. While doing this, careful watch must be kept for any fistulous communication between the gall-bladder and the bowel ; if one exists and it is accidentally opened, the aperture in the bowel should be closed by Lembert sutures in the ordinary manner. When the position of the stone has been made out, the packing is readjusted so as to make sure that no bile can escape into the general peritoneal cavity. The exact procedure for the removal of the stone will vary somewhat according to its position in the duct.

When the stone lies in the first part of the common duct, the incision into it will be made above the pancreas and the duodenum, and directly over the stone; the calculus is then easily removed. In making this incision it is important to fix the stone so that it does not slip about, as in some cases the duct is dilated and the stone slips away and may easily pass up into the hepatic duct where it is very difficult of access. The best plan is to introduce the finger through the foramen of Winslow, hook it round behind the stone, and press the latter forcibly forward so that it is firmly fixed. In making the incision into the common duct it is very useful, if there are only a few adhesions, to incise first the peritoneal covering and then the wall of the duct separately ; this facilitates the introduction of stitches subsequently. If there are many adhesions there will be no distinction between the peritoneal covering and the duct wall.

When the stone lies in the second part of the duct, the best plan is to

squeeze it up into the first part and cut down upon it there (*vide supra*). Should this be impossible, the duct must be incised as near to the stone as the surgeon can reach without damaging either the duodenum or the pancreas, these structures being turned forwards as far as possible. A suitable pair of forceps or a scoop is passed into the incision and the stone extracted whole if possible, or, if not, in fragments.

Incision of the common duct is followed by the escape of bile, sometimes in large quantities. When the duct is much dilated, it is well to make a small incision into it in the first instance, so as to avoid having the wound flooded with a large quantity of bile, and a red rubber catheter may be slipped into the opening in the duct in order to carry off the bulk of the bile, any that escapes alongside the tube being rapidly mopped up with sterilised pads, which should be at hand in large numbers and should not be used a second time ; they should be fixed in forceps so that they cannot be left behind. When the pressure of the bile has diminished, the incision may be enlarged and the stone removed as mentioned above ; the whole length of the duct should then be palpated and a suitable probe introduced so as to explore the duct both upwards and downwards.

As in these cases the bile-duct is infected and more or less cholangitis is present, and as it is not always certain that the orifice of the bile-duct is sufficiently wide to permit of satisfactory drainage of the bile-ducts if the opening made in the common duct is closed, it is always well to drain the common duct for a few days ; this is essential when acute cholangitis is present. Drainage is effected by using a red rubber drainage tube of suitable size with a lateral opening near its end which is brought opposite the entrance of the left hepatic duct into the common duct. This tube should fit the incision in the duct, and is fixed in place by a fine absorbable catgut stitch passed through the two cut edges and the drainage tube ; if the opening in the duct is very large it may be surrounded by a purse-string suture which will obviate all danger of leakage of the bile. The tube is connected with a bottle as in cholecystostomy (see p. 49) and may usually be left out in a week. As the tube fits the opening in the duct no packing is necessary, but it is well to introduce a separate large drainage tube down to the bottom of the wound for a few days. These tubes may emerge at the upper end of the incision or, if more convenient, through separate stab-openings, the main incision in the latter case being closed by through-and-through sutures.

Some surgeons also perform cholecystostomy in these cases, so as to drain the gall-bladder and cure any cholecystitis and thus minimise the chance of fresh formation of stones. On this point the surgeon will be guided largely by the condition which he finds ; if there are stones in the gall-bladder or if it is inflamed, it is well to drain it ; if however it is shrunken and contains no stones it may not be possible to do this. If it is shrunken and contains stones, cholecystectomy should be performed if the patient's condition admits.

If suture of the duct is decided on, it may be performed in several ways, and there are great differences in the ease with which it can be done according to the depth at which the duct lies from the surface and the presence or absence of adhesions. The fullest possible retraction of the wound should be effected by the assistant, the free edge of the liver should be drawn up and the duodenum pushed downwards as far as possible. A good light and good sponging are essential, as the escape of bile and the troublesome oozing from the plexus of veins lying over the common duct may hamper the surgeon very much. The fine needles recommended by Mr. Arbuthnot Lane for cleft-palate operations, passed by means of their special needle-holder, are often useful; others use a rectangular cleft-palate needle, and others again prefer fine, curved Hagedorn needles.

We prefer to press forward the duct with the forefinger in the foramen of Winslow, and to use curved intestinal needles in a needle-holder. We always try to avoid taking up the mucuous membrane of the duct in the stitch, but this is not always possible. Two rows of interrupted catgut sutures should be inserted, the first layer passing through the outer wall of the duct and the second through the peritoneum over it whenever it is possible to differentiate between these two structures. Perfect closure of the incision may be obtained in this manner, and no leakage of bile is likely to take place; when there are many adhesions, however, the distinction between the two structures will not be marked, and one layer of sutures must suffice. A drainage tube should always be inserted down to the duct.

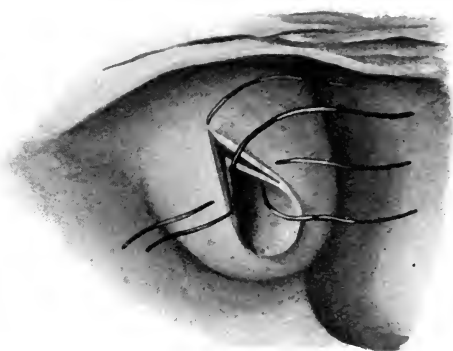
When the stone is impacted in the terminal third of the duct, especially when it lies in the ampulla of Vater, the surgeon has several courses open to him. He may attempt to squeeze the stone higher up in the duct and then remove it in the manner recommended above; this, however, is not usually successful. He may attempt to crush or to needle the stone, but this cannot be recommended. The method we advise, when an attempt to push up the stone has failed, is to incise the anterior wall of the second part of the duodenum parallel to its long axis and over the situation of the orifice of the duct, and then identify and slit up the latter and extract the stone with forceps or a scoop. The duodenum should be emptied of its contents and clamped if possible on either side with intestinal clamps; but if this is impossible, it should be squeezed empty and occluded by the pressure of an assistant's fingers until the incision has been made, when the edges of the incision are held well up and any contents mopped up as they appear. The orifice of the small papilla in which the duct ends is now slit up; if that is indistinguishable, the surgeon cuts down directly over the stone. In slitting up or incising the duct in this manner, it is important not to carry the incision too high up, otherwise the cellular tissue behind the duodenum may be cut into; as a precaution against extravasation of bile, it is well to insert a fine catgut suture on each side



I



II



III



IV

FIG. 14.—REMOVAL OF A CALCULUS FROM THE AMPULLA OF VATER. The four stages of the operation shown are: the incision into the papilla; the stone extruding; the sutures inserted between the wall of the duodenum and that of the common bile-duct; and the sutures tied.

as shown in Fig. 14. After the incision has been made, the stone is removed with forceps or a scoop. A probe is then passed up along the duct to see if other stones are present, and if so they are pushed downwards and extracted through the same opening. The anterior wall of the duodenum is closed as after enterotomy, the packing removed, and the abdominal wall sewn up, a drainage tube being inserted for two or three days.

After-treatment.—The after-treatment is in the main that for any severe laparotomy. After the drainage tube has been removed (about



FIG. 15.—THE SLING-PILLOW FOR MAINTAINING THE 'FOWLER POSITION' AFTER OPERATIONS UPON THE BILE-PASSAGES. By altering the length of the straps the patient can be made to sit more upright. (Mayo Robson, in *A System of Operative Surgery*, edited by F. F. Burghard.)

the eighth or tenth day) the biliary fistula will gradually close if there is no obstruction to the ducts. It may break open once or twice, possibly from some slight recrudescence of cholangitis, but healing usually remains quite sound after three months.

In the general treatment special care must be taken to guard against broncho-pneumonia or pleurisy, which are fairly frequent affections, and are probably due to the immobility of the diaphragm and the bases of the lungs. The best preventive is to place the patient in the 'Fowler position' (see Fig. 15) from an early period after the operation.

An occasional trouble, to which we have already referred (see p. 39), is persistent oozing of blood, and for this some surgeons are in the habit of draining the right kidney-pouch through a stab-wound in the loin just outside the kidney, whenever there is much oozing in a deeply jaundiced patient. The bleeding may be checked partly by the continued administration of calcium lactate by the rectum, and partly by soaking the deeper layers of the gauze packing in a solution of adrenalin chloride (1 in 1000). The administration of normal horse serum subcutaneously is recommended for this purpose; if that fails, opening the wound and applying firm pressure, or under-running bleeding vessels or applying the actual cautery may succeed. The wound may also have to be opened up after cholecystostomy in order to remove stitches, about which fresh biliary calculi are forming. This trouble can be avoided if the stitches are either composed of absorbable catgut with the ends cut short, or silkworm-gut with the ends cut long, so that they can be removed without opening up the wound. Another cause for which the wound occasionally wants re-opening, and a very serious and troublesome complication, is the formation of dense adhesions between the seat of the operation and the duodenum, pylorus, or colon; occasionally actual stricture of the bowel may thus be produced. When these adhesions have existed before the operation, and have been separated, it is well, before closing the abdomen, to interpose a piece of omentum between the raw surfaces. Further, an operation may be required later on for ventral hernia or for persistent biliary fistula (*vide infra*).

Cholecystenterostomy. — When the patient's condition does not allow of choledochotomy, the operation of cholecystenterostomy may be performed. This has for its object the establishment of a fistulous communication between the gall-bladder and the intestine, preferably the duodenum, or, failing that, the colon. The object of the operation is to avoid a biliary fistula, which of course will be permanent if it is impossible to remove the stone from the duct or if the obstruction happens to be malignant. In the latter case the operation is a good and a legitimate one. We should reserve cholecystenterostomy for cases in which the obstruction is irremovable, since a permanent connection with the bowel must always expose the bile-passages to the risk of septic infection. If the obstruction is removable, but removal cannot be undertaken because of the patient's feeble condition, we should prefer to drain the gall-bladder by means of cholecystostomy (see p. 48) and trust that an operation for removal of the obstruction might be successfully undertaken at a later period.

Cholecystenterostomy is performed in much the same manner as gastro-jejunostomy (see Vol. IV. p. 265), the contents of the gall-bladder being first removed by a trochar and canula. Special clamp forceps, like those used for gastro-jejunostomy but smaller, have been introduced to facilitate the operation. The opening should be about an inch in

length. It is well not to insert an inner layer of stitches uniting the mucous membrane of the gall-bladder to that of the intestine, as in gastro-jejunostomy, as these stitches may become the nuclei of stones. A single continuous Lembert suture of ordinary absorbable catgut, reinforced by a few interrupted stitches outside, will suffice. In putting in the stitches care must be taken that they do not penetrate the wall of the gall-bladder.

When the gall-bladder is extremely small and the common duct is widely dilated the common bile-duct has been united to the duodenum—*choledocho-duodenostomy*—but this is rarely feasible. It is done in a similar manner to the above, but it is much more difficult.

BILIARY FISTULA.

It not infrequently happens that a patient, either as a result of some operative interference or of a suppurating gall-bladder, suffers from a biliary fistula, which will be permanent unless surgical measures be undertaken for its cure. Biliary fistula may be due to one of the following causes :—

1. Gall-stones impacted in the cystic duct.
2. Kinking of the cystic duct from adhesions about the neck of the gall-bladder or the cystic duct.
3. Obliteration of the cystic duct by inflammation or new growth.
4. Non-closure of a cholecystostomy wound.
5. Gall-stones impacted in the common duct.
6. Occlusion of the common duct by new growths or cicatrices.

A persistent biliary fistula is a most unpleasant condition. When the cause is in the cystic duct, the discharge from the fistula as a rule is a thin, mucoid fluid ; when, however, it is in the common duct, bile pours out of the fistula in large quantities. Although a fistula through which no bile escapes does not cause irritation of the skin, it is inconvenient and requires constant attention, whilst a true biliary fistula may give rise not only to much annoyance from staining of the linen by the bile, but to irritation of the skin around. Therefore surgical intervention will be called for in the majority of cases.

TREATMENT.—*When the fistula is due to a stone impacted in the cystic duct*, attempts should first be made to localise the stone by a probe and then to extract it with suitable forceps. Should these fail, the surgeon must open the abdomen and perform cholecystectomy if the condition of affairs permits (see p. 50) ; if not, the stone should be extracted through an incision directly over it, and the entire mucous membrane removed from the gall-bladder and the cystic duct. Finally, drainage is provided until the cavity closes, as it will if the mucous membrane has been completely removed.

When the fistula is due to kinking of the cystic duct or the neck of the gall-bladder or to stricture, the abdomen should be opened, the fundus freed from the abdominal wall, and cholecystectomy performed, the cystic duct being removed with the gall-bladder (see p. 50). In doing this, great care must be taken to see that only the cystic duct is removed and not a portion of the common duct where the cystic duct joins it.

3. *When the fistula is due to want of closure from faulty suture after cholecystostomy*, a laparotomy should be done, the fundus separated from the abdominal wall, its edges pared, and the wound in the gall-bladder closed by Lembert's sutures in the ordinary fashion. The sutured gall-bladder should then be dropped back into the abdomen, drainage being provided down to the seat of operation (see p. 47).

4. *When the fistula is due to a stone impacted in the common duct*, abdominal section should be performed and choledochotomy undertaken. Should that prove impossible, cholecystenterostomy may be done.

5. *When the fistula is due to the occlusion of the common duct by a new growth*, the tumour will probably be malignant and hence the advantage to be gained from operative interference for the cure of the fistula, which could only take the form of cholecystenterostomy, does not counterbalance the risks. A biliary fistula due to this cause should rarely be met with as, when the abdomen has been opened and a malignant growth occluding the common duct has been found, it will be better either to leave the case alone or to perform cholecystenterostomy at once in preference to cholecystostomy.

When the fistula follows stenosis of the duct due to rupture from injury and subsequent cicatricial contraction the outlook is better, as, although it may be impossible to render the duct patent again, the flow of bile may be diverted from the fistula into the intestine by performing cholecystenterostomy and closing both ends of the divided duct.

CHAPTER VI.

THE SURGICAL AFFECTIONS OF THE SPLEEN.

INJURIES.

INJURIES of this organ may be divided into penetrating wounds, and contusions or ruptures. *Penetrating wounds* are comparatively seldom met with, owing to the sheltered position of the organ beneath the ribs, and are generally caused by firearms. *Contusions and ruptures of the spleen* are more common, and, in a healthy spleen, are caused by severe blows, such as a kick from a horse or a run-over accident, and are therefore generally accompanied by other injuries; when the spleen is enlarged; however; a comparatively slight injury may produce rupture. In some cases there may be merely extravasation of blood within the capsule of the organ, but in more severe cases the spleen is ruptured to a varying degree and may even be completely pulped up. When the serous envelope of the spleen is torn, death from hæmorrhage is liable to follow, either immediately or in a comparatively short time.

The *symptoms* of rupture of the spleen are profound shock and signs of intra-abdominal hæmorrhage. That the spleen is the organ injured may be suspected if there has been an injury in the splenic region and if the signs of hæmorrhage are severe; if the patient has an enlarged spleen the probability that that organ has been injured is much greater. There is often tenderness and an increase of dullness in the splenic area.

TREATMENT.—Should the patient live long enough, the abdomen must be opened at once. If it is evident before commencing the operation that the spleen is the organ ruptured, the best incision is one parallel to and an inch below the left costal margin. When the diagnosis is uncertain, however, the incision should be an inch to the left of the middle line and, if large enough, this gives good access to the spleen unless the patient is stout; in that case a transverse incision outwards to the left, just above the level of the umbilicus, may be added. When the abdomen has been opened, the clot is rapidly turned out, the hand slipped in, the

spleen felt for, and its pedicle compressed between the finger and thumb, so as to stop the bleeding. An assistant clears away the blood with sponges, and the lesion in the organ is then examined and further treatment decided upon.

If there is merely *a rent in the capsule of the spleen*, or a small penetrating wound, an attempt may be made to arrest the bleeding by passing deep mattress sutures through the spleen at least an inch from the cut surface on each side, so as to compress the splenic tissue in the same manner as in rupture of the liver (see Chap. II.). A continuous suture is then put into the capsule and, before returning the spleen, an examination is made for any other injury.

In the great majority of cases, however, there is *a severe contusion or a rupture*, and the only treatment is to remove the spleen; the operation is described on p. 65. The first step is to clamp the pedicle with long pressure-forceps, and then rapidly remove the organ, taking care not to cut the pedicle too close to the forceps. The extravasated blood is then cleared out and the pedicle secured permanently. During or after the operation it will probably be found necessary to administer saline solution intravenously (see Vol. I.).

Unless the patient has lost too much blood, recovery is usually quite satisfactory, and during it the superficial glands enlarge and remain hypertrophied. Occasionally, however, the loss of the spleen has led to serious symptoms; for example, a patient from whom the spleen was removed for injury began, after convalescence, to go downhill with weakness, emaciation, thirst, and drowsiness. She was given extract of sheep's spleen and raw bone-marrow daily, and recovered completely. In another very similar case cod-liver oil and bone-marrow, and, subsequently, arsenic, were administered with good results.

PROLAPSE.

When there is a large penetrating wound of the abdominal wall over the splenic region the spleen may prolapse, and the question will arise as to the best method of treatment. If the organ has not been injured it should be cleansed and returned into the abdomen, but in most cases it will be damaged and bleeding freely. If the wound in the spleen is slight, it may be closed and the organ returned, but in most cases there will probably be no alternative but to remove the spleen (see p. 65).

WANDERING SPLEEN.

This condition is not at all uncommon. It occasionally follows injury, but more frequently arises spontaneously, the attachments of the spleen becoming unduly stretched; indeed, the pedicle may be

converted into a cord and in that case torsion and consequent gangrene of the organ may occur. The degree of mobility varies ; sometimes the spleen merely moves out from under the ribs for a short distance, whilst in bad cases it wanders widely over the abdomen, especially towards the left iliac fossa ; it has even been found in the pelvis.

A wandering spleen is generally also enlarged, and the enlargement may either be the primary cause of the mischief, or it may be secondary

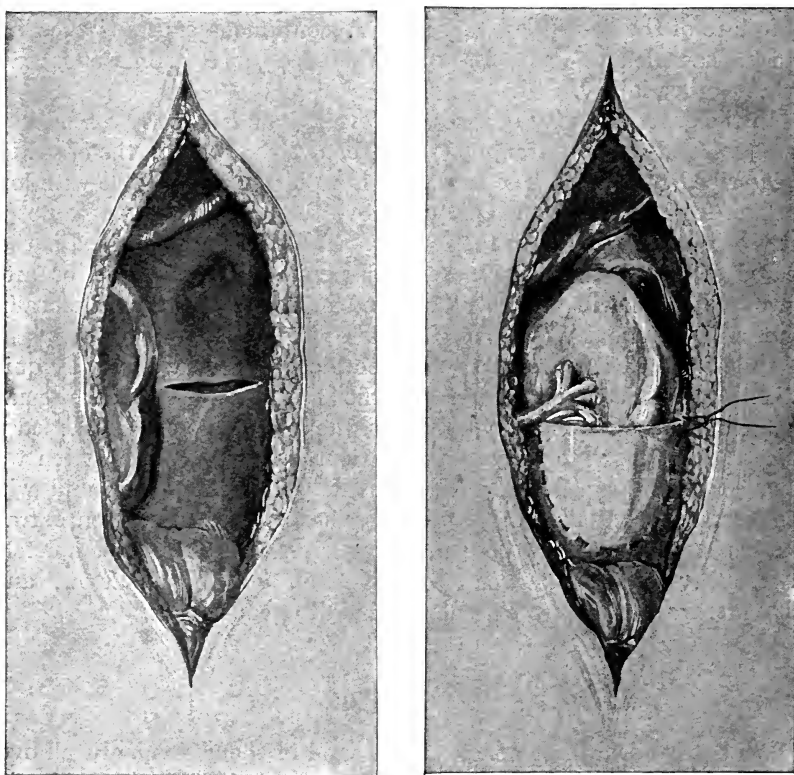


FIG. 16.—SPLENOPEXY BY RYDYGIER'S METHOD. The left-hand figure shows the incision made in the peritoneum, while the right-hand one shows the pocket formed and the spleen in position. (Moynihan, in *A System of Operative Surgery*, edited by F. F. Burghard.)

to the undue mobility causing repeated congestion of the organ, from kinking of the pedicle.

The *symptoms* are comparatively few ; there is slight pain and uneasiness about the left side, with occasional intestinal symptoms from pressure. The only condition with which the affection is likely to be confused is movable left kidney. The size and shape of the organ should, however, render the diagnosis easy ; it is generally possible to feel the notch in the anterior margin of the spleen.

TREATMENT.—*In mild cases without marked pain* the best plan is to employ a well-fitting belt in the first instance. This generally suffices to make the patient comfortable ; but if not, the surgeon has the choice between splenopexy or fixation of the organ, and splenectomy. The latter will naturally cure the troubles, and the results are satisfactory unless the spleen is diseased. At the same time, the operation is a serious one, and should only be performed when the patient is gravely incapacitated and no other measures suffice, as, apart from the risks of the operation itself (*vide infra*), the mere loss of the spleen may affect the patient deleteriously.

Splenopexy.—In performing splenopexy it is not sufficient simply to pass sutures between the capsule of the spleen and the under-surface of the diaphragm, as no satisfactory adhesions result and the spleen soon becomes loose again. The following plan introduced by Rydygier (*Archiv f. klin. Chir.*, 1895), is perhaps the most likely to be successful.

The abdomen is opened by a vertical incision just internal to the outer margin of the left rectus and the spleen is exposed. A pocket is then made beneath the parietal peritoneum covering the diaphragm and abdominal wall, into which the lower end of the organ is inserted and fixed. To do this, a transverse incision is made through the peritoneum covering the diaphragm on a level with the ninth intercostal space, and the peritoneum is separated from the abdominal wall downwards with the finger or the handle of the knife so as to form a pocket to receive the spleen. In order to limit the separation of the peritoneum from the wall of the abdomen below and to prevent the spleen increasing this separation by its weight and slipping too far down in the pocket, a few stitches may be passed through the parietal peritoneum and the subjacent muscle at the lower limit of the pocket. The lower part of the spleen is now placed in this pocket and the free border of the pocket is fastened to the gastro-splenic omentum by a few catgut sutures (see Fig. 16). This operation is only suitable for cases of wandering spleen that have not undergone any considerable enlargement. When the spleen is much enlarged, splenectomy is the better operation (see p. 65).

INFLAMMATORY AFFECTIONS.

Inflammation and abscess of the spleen usually occur in connection with some general septic infection, and local surgical treatment will seldom be sufficient.

ABSCESS.

An abscess of the spleen occasionally occurs as an independent affection—for instance after typhoid fever—but its diagnosis is extremely

difficult. There is enlargement of the spleen with pain and tenderness on deep pressure, fever, and the usual symptoms indicating suppuration.

TREATMENT.—Theoretically, localised abscesses in the spleen admit of drainage, just as hepatic abscesses do, and this is the proper treatment if the diagnosis can be made. An incision should be made over the most prominent part of the tumour, if possible below the margin of the ribs; sometimes it may have to be made through an intercostal space. The spleen should then be attached to the abdominal wall and the abscess opened by Hilton's method and efficiently drained. Any unduly free bleeding could be met by plugging.

The spleen has been extirpated successfully for this condition, and splenectomy has also been suggested for cases in which there are numerous abscesses scattered through the organ, but these are usually cases of general pyæmia.

SYPHILIS AND TUBERCULOSIS.

Tuberculosis of the spleen is always a part of tuberculosis elsewhere and does not call for surgical treatment.

Syphilis of the spleen is very rare and is more interesting from the point of view of diagnosis than of treatment. The latter is that for tertiary syphilis (see Vol. I. Chap. XI.), in which stage the affection of this organ occurs.

HYDATIDS.

The spleen may be implicated alone, or, more usually, in conjunction with the liver or other organs. The cyst makes its way forward towards the abdominal wall and presents the typical characters (see Chap. III.), or it makes its way upwards and backwards, contracting adhesions to the diaphragm and eventually opening into the pleura or the lung. The diagnosis is made from data similar to those in connection with the liver.

TREATMENT.—This consists in opening the cyst with suitable precautions against infection of the peritoneal cavity, evacuating its contents, and providing drainage (see Hydatid of the Liver). Splenectomy has been suggested, but incision and drainage seem more suitable; in the case of a large cyst, there may be many adhesions, and an attempt at splenectomy would be accompanied by much shock and bleeding, while drainage is safer, simpler, and gives equally good results. If, however, there are a number of comparatively small cysts, it will be better to remove the spleen.

The treatment of a hydatid of the spleen that has opened into the thorax, is identical with that of the similar condition in the liver:

TUMOURS.

These rare affections are generally sarcomatous, and spring from the capsule of the organ. Adhesions to neighbouring structures soon occur, and complete removal is thus rendered difficult.

TREATMENT.—Splenectomy is called for, but before proceeding to excision the condition of matters as regards adhesions to the stomach and colon must be made out; if extensive adhesions are present, the operation had better be abandoned.

ENLARGEMENT.

The commonest cause of splenic enlargement is *malaria*, in which the spleen may attain an enormous size and cause great discomfort. A similar enlargement may accompany *leucocythæmia*—a condition in which there are profound changes in the blood and lymphatic glands. Enlargement also occurs as a result of *cirrhosis of the liver, or cardiac disease*. Simple or *idiopathic enlargement or primary splenic anæmia*, due to an increase in the glandular tissue, is also met with, but its cause is unknown.

This affection (sometimes termed 'primary splenomegaly') is characterised by diminution in the number of red corpuscles, lowering of the percentage of hæmoglobin, leucopenia, and enlargement of the spleen not connected with any known cause. It is almost always fatal unless splenectomy is done.

Enlargement of the spleen may cause much discomfort and ill-health apart from any actual blood changes. Splenectomy has been done in a large number of cases with results varying to a great extent with the nature of the primary cause. Thus the great majority of patients suffering from leucocythæmia die after splenectomy, and the result of a large number of operations seems to show that the operation is unjustifiable for this condition. The mortality of splenectomy for malarial enlargement is also considerable, and the operation should not be done unless the patient be suffering severely from the pressure effects of a very large spleen.

This leaves only the so-called primary splenic anæmia or idiopathic enlargement of the spleen as a legitimate object of splenectomy. A considerable number of cases have been done for this condition with success, and operation is called for provided that the symptoms are not arrested by medical means. It should always be done before adhesions of the spleen have taken place.

Splenectomy.—The greatest care must be taken to arrest all hæmorrhage. Every oozing point in the abdominal incision should be clamped as soon as it is met with and subsequently ligatured, otherwise it is apt to ooze afterwards.

The spleen is best exposed through a vertical incision through the outer edge of the left rectus from the costal margin to well below the umbilicus. The incision must be large enough to allow the organ to be delivered through it without the least traction. The spleen is first examined to see if there are any extensive adhesions; if there are, the operation is contra-indicated because of the danger from the oozing which will persist after the wound is closed.

When there are no extensive adhesions the spleen is delivered through

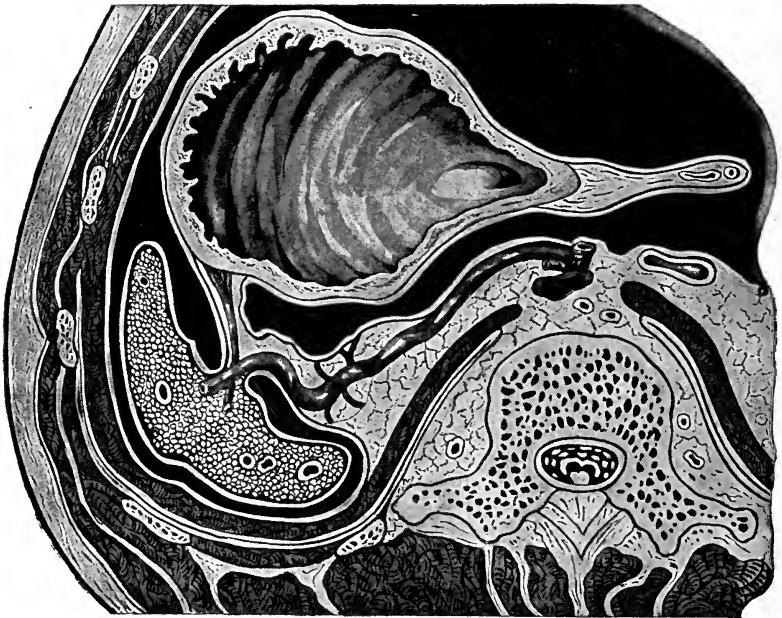


FIG. 17.—TRANSVERSE SECTION OF THE ABDOMINAL CAVITY, TO SHOW THE ARRANGEMENT OF THE LIGAMENTS OF THE SPLEEN AND THE COURSE OF ITS BLOOD-VESSELS. (Moynihan, in *A System of Operative Surgery*, edited by F. F. Burghard.)

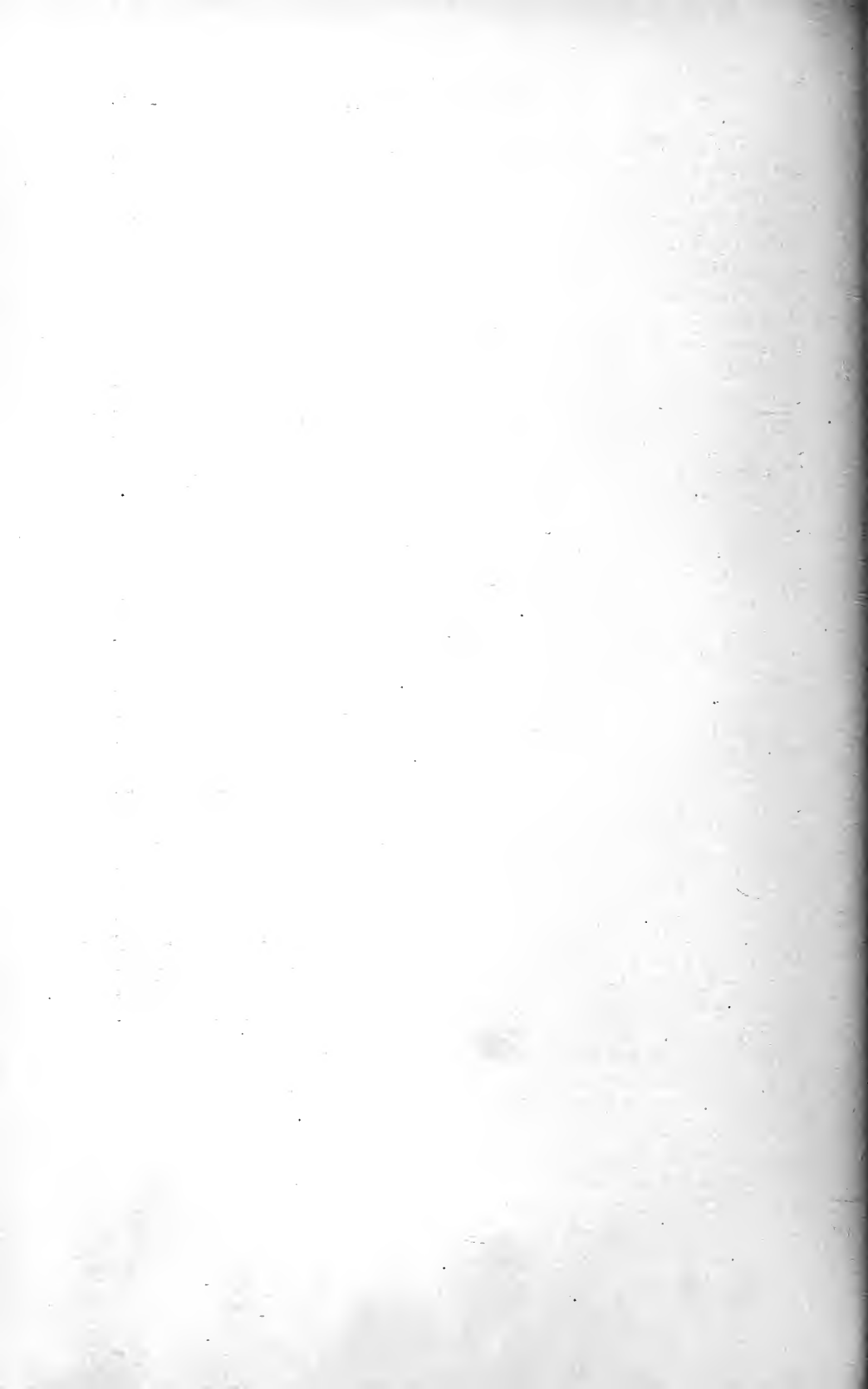
the wound so that it lies upon the surface of the abdomen, and the remainder of the operation is performed outside the abdominal cavity. The greatest gentleness must be used in delivering the spleen, otherwise it may be torn and fatal hæmorrhage may easily occur; the wound must be enlarged as much as may be necessary to allow of the easiest manipulation. In particular, traction upon the pedicle must be avoided, as the splenic vein is readily torn and traction may also cause profound shock from disturbance of the sympathetic plexuses. Before the organ is drawn out of the wound, the position of the pedicle must be noted so that the surgeon can at once control it should any accident occur. Fig. 17 shows the position of the spleen and the arrangement of its ligaments.

If the patient's condition is good and there is no particular hurry, the layers of the gastro-splenic omentum should be divided separately between forceps. When the gastro-splenic omentum has been thus divided the lienorenal ligament comes at once into view and the individual branches of the splenic vessels may be isolated, tied in two places, and divided between the ligatures. It is important to tie the ligatures before the spleen is actually removed, otherwise the forceps controlling the vessels are pulled high up under the dome of the diaphragm and the ligatures are very difficult to tie. The number of ligatures will vary according to the breadth of the pedicle. In cases of great enlargement the vessels are of enormous size, but if they are methodically seized in two pairs of clamp-forceps, as directed above, there is no difficulty in securing a bloodless operation and no need to employ massive ligatures. The ends of the ligatures should be left long until the pedicle has been completely divided and carefully examined to see that there is no bleeding; they may then be cut short and the pedicle dropped into the abdomen.

When the patient is feeble and time is of importance, the best plan is to clamp the pedicle and the other attachments of the spleen at once with long pressure-forceps and to cut the organ away rapidly. When this has been done, attention is turned to the vessels behind the clamps, which should be tied by a series of interlocking ligatures applied sufficiently far back to obviate any risk of slipping. There must be no traction upon the pedicle as the ligature is tightened. If there is time, the more important vessels may also be picked up and tied separately upon the face of the pedicle.

Should oozing continue, although all obvious bleeding points have been tied, it may be necessary to pack the cavity with gauze, in which case it will be imperative to leave a portion of the abdominal incision open. This, however, should rarely be necessary because the operation should not be undertaken if the adhesions are bad enough to cause much oozing.

The *after-treatment* is that for laparotomy in general, the abdominal wall being sutured in three layers as usual (see Vol. IV. p. 214). It may be necessary to employ intravenous saline infusion when the shock has been considerable or, in cases of splenectomy performed for injury, when the combined shock and loss of blood have rendered the patient very collapsed.



DIVISION II.

THE SURGICAL AFFECTIONS OF THE NECK.

CHAPTER VII.

DEFORMITIES, INJURIES, INFLAMMATORY AFFECTIONS AND TUMOURS OF THE NECK.

CONGENITAL MALFORMATIONS.

THE following are the chief congenital malformations which occur in the neck : *Fistulæ* and cysts, in connection with (*a*) the branchial clefts ; (*b*) imperfect closure of the neck ; and (*c*) the thyroglossal duct (see p. 124) ; pharyngeal and œsophageal fistulæ and pouches (see Vol. IV. p. 119) ; dermoid cysts (see p. 89) ; lymphangiomata (cystic hygroma) (see p. 89) ; and cervical ribs. Congenital wryneck, so called, is probably a condition developed after birth, and therefore we consider it along with wryneck in general.

BRANCHIAL FISTULÆ AND BRANCHIOGENIC CYSTS.

These are the remains of the branchial clefts, and the position of the fistula depends upon the particular cleft from which it arises ; in almost all cases these fistulæ arise in connection with the second cleft. The opening of the fistula is generally situated at the anterior margin of the sterno-mastoid muscle, just above the sterno-clavicular articulation, and it is not uncommon to find a small portion of cartilage at the orifice of the sinus. The canal is usually narrow, but well defined, and may be long and tortuous, frequently passing between the internal and external carotid arteries. At the upper part it runs along the internal carotid artery, passing under the styloglossus and stylopharyngeus muscles, and over

the hypoglossal and glossopharyngeal nerves. It has usually only an external orifice, and does not communicate directly with the pharynx, though it generally comes into close connection with it in the neighbourhood of the tonsil; if there is an internal opening it is in that situation.

When the branchial cleft is closed at both ends, but not throughout its whole length, the intervening portion may become dilated and give rise to a cyst, or a chain of cysts, which may only become evident comparatively late in life. Two kinds of cysts are formed according to the part of the cleft which is patent and the character of the epithelium lining it. In the most common form the epithelium is squamous and the contents are of the regular dermoid type. More rarely, the cyst contains a thin mucoid fluid, and the epithelium lining it is cylindrical or ciliated.

These branchiogenic tumours usually occur in the upper part of the anterior triangle of the neck about the level of the hyoid bone and beneath the deep cervical fascia. The dermoids form oval unilocular tumours which feel lax and fluctuate; the mucous form may be multilocular and translucent. The skin is normal and not attached to the tumour which has no outlying nodules or enlarged glands. When large, the swelling may lift up the sterno-mastoid and project into the posterior triangle. As a rule the mucous form is noticed at or immediately after birth, whereas the dermoid is not discovered until after puberty. These cysts gradually increase in size, and in some cases epithelioma may develop in connection with them in later life.

TREATMENT.—The removal of a long, narrow, fistulous track of this kind is always a matter of extreme difficulty, and, if it is not completely taken away, the fistula will recur or a cyst will form in connection with the part left. It is not uncommon to find that the patient's condition is made worse by the operation, and therefore in most cases the fistula is better left alone, unless it is a source of real annoyance; when, however, there is a communication with the pharynx or a troublesome discharge of mucus, an attempt may be made to dissect out the fistula. The first step is to pass a fine probe along the whole length of the canal, which is then exposed by an incision running along the anterior border of the sterno-mastoid. Great care is necessary to avoid cutting across the fistulous track, otherwise it may be lost. Very delicate dissection is needed to isolate it throughout, and the probe should be maintained in position until the whole track has been satisfactorily defined. It is then detached above at its connection with the pharynx, and if a communication results, the small aperture is inverted and closed by fine catgut sutures inserted after Lembert's method. When a communication has been made with the pharynx, it is well to insert a small drainage tube for two or three days lest sepsis should occur.

Attempts to destroy the lining membrane of the canal with caustics, the sharp spoon, or the actual cautery in place of dissecting out the tube

practically always fail, and, even should they succeed in bringing about closure of the external orifice, this will be followed by the formation of a cystic swelling in the neck.

Cysts should be completely removed; a partial operation will be followed by reproduction of the cyst, and will render subsequent removal of the cyst wall much more difficult. A transverse incision should be made over the tumour and the dissection should be very carefully carried out, bearing in mind that the cyst is often closely connected with the vessels and other important structures in the neck. Sometimes the cyst can be easily shelled out; in other cases a portion is so adherent to important structures in the neck that it cannot be entirely taken away. Should this be the case, an attempt should be made to denude the portion left behind of its epithelium by cutting, scraping, and cauterisation; but the result is uncertain.

Congenital fistulæ may also, though very rarely, occur in connection with the cervical sinus, the deep groove which is produced by the telescoping of the lower part of the neck into the upper during the process of development. They are generally situated higher up.

SUPERNUMERARY OR CERVICAL RIBS.

Supernumerary or cervical ribs are connected with the transverse process of the seventh cervical vertebra and may be well formed, extending down to the first rib, or only partial, their lower end being free. The degree of development may differ on the two sides of the neck. Their lower end may be anchylosed by bone to the first rib; sometimes the spinal end alone is anchylosed. The rib may be developed separately from the seventh cervical transverse process, but sometimes the supernumerary rib appears to be a true enlargement of this latter process; this may be called a 'false' cervical rib in contrast to the other or 'true' form. Both varieties may occur in the same patient and may be bilateral or unilateral. Radiograms show that cervical ribs are not infrequent in children, but for many years the patient may have no trouble and may not recognise that any deformity exists; they occur, or, at any rate are most often noticed, in women. It is commonly the visible deformity that calls attention to the condition, but sometimes there is tenderness in the posterior triangle, with pain down the arm or in the brachial plexus or even anæsthesia or paresis in the hand. In some cases the swelling is mistaken for an aneurysm of the subclavian artery owing to the projection forwards of the vessel. When pain or paresis is present it is always advisable to exclude lesions of the spinal cord before deciding that the symptoms are due to the supernumerary rib.

TREATMENT.—Operative interference should only be undertaken when severe symptoms are present; for the mere deformity, which is often slight, it is hardly justifiable to submit the patient to a tedious

and somewhat severe operation involving a difficult dissection of an important region. When, however, there is severe pain in the arm and neck, and especially when there is anæsthesia and loss of power in the hand, it is necessary to cut down upon and remove the bony process. The chief difficulty in the operation is the position of the pleura which lies immediately behind the rib and is usually intimately connected with the periosteum, and may easily be punctured. The brachial plexus and the subclavian artery lie over the front of the rib, but they are fairly easily displaced to one side. The rib may be reached either from the front or the back.

Anterior operation.—A transverse curved incision with its convexity downwards is made in the posterior triangle, just above the clavicle from



FIG. 18.—INCISION FOR THE REMOVAL OF A CERVICAL RIB.

the middle of the sterno-mastoid muscle to the anterior part of the trapezius (see Fig. 18). The flaps are undermined and retracted, the deep fascia opened, the external jugular vein displaced inwards or divided, the posterior edge of the sterno-mastoid pulled firmly inwards with a large retractor, the omo-hyoid muscle defined and pulled up, and the subclavian artery and the brachial nerves lying upon the rib exposed. Usually the nerve cords can be displaced outwards and the subclavian artery downwards, but great care must be taken not to exert undue

traction upon the nerves, as otherwise symptoms such as 'winged scapula' from paralysis of the nerve of Bell may subsequently occur. The best way to avoid damage to surrounding structures is to incise the periosteum freely along the edge of the rib, and to insinuate a curved periosteum detacher between it and the bone, and strip off the periosteum. As soon as this has been effected, a pair of cutting-pliers is slipped in between the periosteum and the rib, and the latter is cut across at its attachment to the spine or the first rib, or to both. When the bone has thus been loosened, it is usually easy to twist it out with the aid of a few touches of the knife leaving the periosteum intact. The stump of the rib is smoothed off with a chisel or cutting-pliers so as not to leave any projection against which the vessels or nerves might be damaged, and then as much as possible of the periosteum is taken away; if it is left behind, a rigid band may form and give rise to pressure upon the nerves. It is possible that the pleura may be opened in doing this, but at this stage of the operation, it is not an accident of great moment. When

the pleura is opened, air passes into the pleural cavity, the lung collapses, and the breathing becomes embarrassed for a time; this usually passes off quickly however, especially if stimulants and oxygen are employed. The opening in the pleura should be closed by sutures and the air in the pleural cavity is rapidly absorbed. A good many surgeons do not remove the periosteum and only advise operation when paralytic symptoms are present, because recurrence of the pain is so apt to take place; this is probably due to the fact that the periosteum has not been removed.

Posterior operation.—The rib may also be readily reached from behind with much less disturbance of the parts and less risk of injury to nerves than in the anterior operation.¹

The following is Bankart's description of the operation; in his case the cervical rib was apparently not attached to the first rib: An incision about four inches long is made parallel to and about an inch from the spinous processes with its centre opposite the seventh cervical vertebra. The trapezius is divided in the same line and drawn outwards so as to expose the deep muscles at the back of the neck. The outer margin of the spinal muscles leads directly to the transverse processes and to the cervical rib at its origin from the seventh cervical vertebra. The rib is divided close to the vertebra, and at once becomes movable and can be readily dissected out from the soft parts. The trapezius is then stitched up with catgut.

TORTICOLLIS.

By torticollis or 'wryneck' is meant an affection in which the sterno-mastoid muscle (and sometimes the other muscles of the neck secondarily) undergoes contraction and produces a marked and characteristic deformity. Usually the affection is limited to one side; but in some instances both sides are affected, in which case however the deformity is different, the head being tilted strongly backwards. The condition may be congenital or acquired; the latter may also be spasmodic.

ACQUIRED TORTICOLLIS.

Temporary contraction of one sterno-mastoid is not uncommon: for instance, in the condition generally spoken of as 'stiff-neck,' which is presumably a rheumatic inflammation of the sheath of the muscle which commonly arises after exposure to cold, and gives rise to a temporary contraction of one or both sterno-mastoids with characteristic deformity. Under suitable treatment this condition passes off in a few days and leaves no ill-effects.

¹ A. S. Bankart, *Lancet*, 1913, vol. i. p. 962.

Contraction of the sterno-mastoid may also occur in connection with acute inflammation of the glands in the anterior and posterior triangles, especially of septic origin. Sometimes it may follow an eruption of boils in the neighbourhood.

A very important cause of wryneck is cervical spinal disease ; when the disease mainly affects one side of the vertebræ the sterno-mastoid on that side may be contracted, and a typical wryneck is produced. This is a possible cause that should never be forgotten when examining a patient with wryneck. In rheumatoid affections of the cervical spine some amount of wryneck is often present.

TREATMENT.—The treatment will depend upon the primary condition, and consists essentially in removal of the cause.

In the ordinary stiff-neck from cold the best treatment is rest, together with the frequent application of hot fomentations, and the administration of a dose of calomel (gr. iii-v), followed by ten-grain doses of salicylate of soda thrice daily ; when the patient is gouty, colchicum and iodide of potassium should be added to the salicylate of soda. The affection is often excessively painful in the early stages, and ten grains of Dover's powder may be given at night to enable the patient to get sleep. As soon as the more acute stage has passed off, which will be in two or three days, the affected side may be rubbed with a liniment (such as the linimentum terebinthinæ aceticum or equal parts of lin. belladonnæ and lin. camph. co.) three or four times a day, and afterwards the neck should be wrapped up in a mass of hot cotton-wool. As a rule, recovery will be complete in a week or ten days ; but if there is a tendency for the condition to become chronic, a course of massage (especially vibratory massage) or a visit to a watering-place, such as Bath, Buxton, or Harrogate (see Vol. III. p. 144), will generally complete the cure. Turkish or hot-air baths are useful under these circumstances.

In cases secondary to acutely inflamed glands the treatment must be directed to the latter (see p. 91). As soon as these subside, the wryneck clears up. When *secondary to spinal disease* the latter must be treated on appropriate lines (see Vol. III. p. 313). Rheumatoid affections must also be treated on the lines laid down in Vol. III. p. 143.

CONGENITAL TORTICOLLIS.

When wryneck is present at or immediately after birth it is usually spoken of as congenital. Children are seldom born with this condition, the generally accepted view being that the deformity develops after birth, usually as the result of some partial rupture of the sterno-mastoid during delivery, although some authorities hold that it is more usually due to malposition *in utero* or some other pre-natal condition.

In congenital wryneck there is a permanent contraction of the sterno-mastoid muscle in which profound changes occur. Besides the

sterno-mastoid, other muscles, such as the trapezius and the splenius capitis, may be affected secondarily, but the shortening in these is usually readily overcome when the contraction of the sterno-mastoid has been rectified. The latter muscle undergoes a fibrous transformation, new fibrous tissue being formed around the muscular fibres, which become compressed and disappear, leaving the affected area of muscle almost entirely transformed into a band of firm fibrous tissue. This change is not limited to the muscular fibres, but affects the sheath of the muscle, so that division of the former alone does not suffice to rectify the deformity. The sterno-mastoid muscle as a rule is unequally affected; generally the sternal head undergoes more extensive alteration than the rest of the muscle and in some the transformation is limited to this portion, which can be felt standing out as a hard, rounded, fibrous cord; the result is considerable shortening of the muscle.

Along with the shortening of the sterno-mastoid, there is well-marked arrest of development of the corresponding half of the head and face. This diminution in size of the affected side may occur in acquired torticollis as well as in the congenital form, so that the lesion is evidently secondary to the development of the wryneck and is not a mere congenital deformity. It is said that atrophy of the corresponding cerebral hemisphere has also been found.

A lateral curvature of the cervical spine may be present along with the torticollis, the concavity being on the affected side; in severe cases there is a compensatory curve in the dorsal region. As a rule this curvature does not lead to permanent alterations in the bones and does not offer any obstacle to the reposition of the head after the muscle has been divided. It is always important to make sure that the case is one of primary torticollis and secondary curvature of the spine, and not primary tuberculous cervical spinal disease with secondary shortening of the sterno-mastoid muscle.

TREATMENT.—All attempts to stretch the muscle mechanically are futile, and nothing but operative measures will succeed. There are two chief points in the treatment: firstly, to remedy the shortening of the sterno-mastoid, and secondly, to maintain the head in its proper position.

Operation.—It is essential to divide the sterno-mastoid muscle and its sheath in order to bring the head into proper position. The splenius, trapezius, and omo-hyoid—which may also be secondarily affected—do not require division; their shortening is only temporary, and is not due to fibrous changes. As a rule, the sternal and clavicular heads of the sterno-mastoid, along with the anterior and posterior layers of its sheath, must be divided. This may be done either by subcutaneous tenotomy or by division of the muscle through an open incision. The open operation is so infinitely superior to the subcutaneous one that it should always be employed, and it is therefore the only one that we shall describe.

A transverse curved incision with its convexity downwards is made across the sterno-mastoid extending a little beyond each border and situated just above the clavicle; the incision should be below the proposed line of section through the muscle. The skin and subcutaneous tissues should be dissected up as a flap, which should include all the tissues superficial to the sterno-mastoid; any vessels which bleed should be ligatured. The deep fascia of the neck is incised along the anterior and posterior borders of the muscle, and the finger or a dissector is insinuated beneath the muscle, so as to raise it and its sheath from the deeper structures.

The whole muscle and its sheath is then divided obliquely upwards and backwards from its anterior margin; this prevents any wide separation between the ends. As the parts are completely exposed, there is little danger of injuring the vessels.

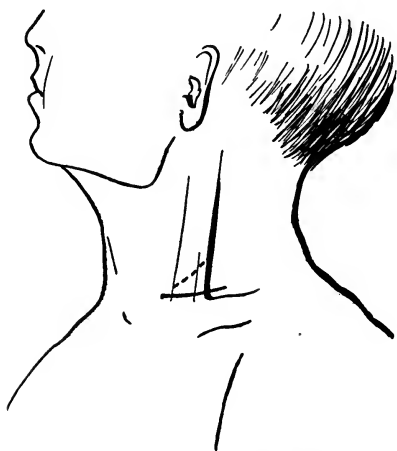


FIG. 19.—DIVISION OF THE STERNO-MASTOID BY AN OPEN OPERATION. The thick line represents the skin-incision; the dotted one the oblique division of the muscle.

The head is now brought into a strongly over-corrected position by an assistant and the wound is explored with the finger to ascertain if any contracted bands remain undivided; these are very commonly found. In bad cases the deep cervical fascia in the neighbourhood is strongly contracted and many bands require division, and it may be necessary to divide the common carotid sheath before the tension is relieved sufficiently. The contracted bands are best shown by rotating the head to the affected

side. In order to effect this properly, the head of the patient should be brought clear over the operating table and moved firmly from side to side until it rotates freely. The head should then be bent over the opposite shoulder and any tense muscles should be carefully kneaded before the wound is stitched up. No drainage tube is used, the edges of the skin being approximated by a subcuticular stitch of horsehair.

The maintenance of reduction.—In cases that are not of long standing all that is necessary after the operation is to place the patient flat on the back, with the head fixed in sand-bags in the corrected position, until the wound has healed. The stitch may be taken out after a week; manipulations, massage and voluntary movements of the muscles can then be commenced, and these often suffice without the use of any apparatus.

In long-standing cases, however, great care must be taken in the after-treatment with the view of improving the nutrition and strength

of the muscles on both sides, and also of preventing contraction of the scar at the seat of the operation and consequent recurrence of the deformity; this can usually be done by massage and manipulations. The massage should be applied to all the muscles of the neck. The manipulations should be gradual but forcible, the head being steadily brought into the over-corrected position and held there for a time. A good home-exercise consists in the patient swinging in an extension head-gear, the cord of which is not attached to the centre of the bar, but to the bar towards the contracted side. The head may be fixed at night in a Minerva collar of poroplastic material for some months.

FUNCTIONAL TORTICOLLIS.

After an acute attack has passed off, it sometimes happens that the wryneck remains, although there is no organic contraction of the affected muscles, and under an anæsthetic the spasm passes off and the head can be placed in a normal position. If the condition does not improve under the administration of antispasmodics—such as bromide or valerian—and the employment of massage and the other methods useful in these neurotic cases, it may be advisable to administer an anæsthetic and apply a plaster of Paris casing, fixing the head and neck in the normal position. This casing must get a good purchase on the thorax and on the lower part of the head. It should be worn for a month and massage of the affected muscles should be carried out when it is left off.

SPASMODIC TORTICOLLIS.

In this condition there are clonic spasms of the sterno-mastoid and other muscles of the neck—especially those in the sub-occipital triangle—the spasms occurring at varying intervals; when the affection has lasted for some time there may be permanent contracture of the muscle. The actual form and character of the movements vary. In some cases the spasm is regular and occurs comparatively slowly, and lasts for a long time; in others there is a frequent and rapid twitching of the muscles. The spasms are not painful as a rule, but in the intervals between them there may be painful tonic contraction. In bad cases there may be constant spasm whenever the head is unsupported, but this often ceases when the patient lies with the head on a pillow, or sometimes when he stands with the head resting against a wall. The spasms are set up or increased by any sudden noise or mental trouble.

TREATMENT.—This may be divided into medicinal and operative measures:—

(a) **Non-operative.**—When the condition is slight, palliative measures may be adopted. Any source of mental anxiety must be removed if

possible, and if the patient is neurasthenic, the appropriate treatment for that condition must be employed. Various nerve sedatives—such as bromides, chloral, or, in bad cases, subcutaneous injections of morphine—may be employed, and the patient should be placed amidst cheerful surroundings and under good hygienic conditions. In bad cases it may be necessary to put the patient in bed and fix the head between sand-bags for some time. It is noteworthy that the spasms often cease when slight support is given to the head. In the less severe cases a head-rest alone may be sufficient, and we have treated cases with success by providing a posterior head-rest attached to a poroplastic band around the chest, so that the patient could rest his head against it whenever he chose, the head not being fixed to the apparatus.

Massage and the galvanic current are perhaps the most useful methods of local treatment. The current should be passed from above downwards along the course of the spinal accessory nerve and should also be applied directly to the affected muscles. The positive pole should be placed over the spinal accessory nerve high up, the negative lower down. A very weak current should be employed at first and gradually increased, and the application should be made daily.

(b) **Operative.**—In severe cases resection of a portion of the spinal accessory nerve and branches of the cervical plexus has been practised. In some cases this has been successful, but the result is frequently disappointing and no relief of the spasm may be obtained. Operation should therefore not be undertaken even in severe cases until a prolonged trial of other measures has been made.

The course of the spinal accessory nerve after its exit from the jugular foramen may be represented by a line drawn at right angles from the centre of another line running from the tip of the mastoid process to the angle of the jaw. The nerve emerges from beneath the posterior belly of the digastric muscle, just superficial to the transverse process of the atlas, and runs downwards and backwards to pierce the sterno-mastoid muscle a little lower down. The following are the details of the operation :—

Neurectomy of the spinal accessory.—The patient lies upon his back with the head turned towards the healthy side, and a transverse or slightly curved incision is made across the upper part of the sterno-mastoid muscle extending on to the anterior triangle of the neck. The skin, superficial fascia, and platysma are divided and turned up; the deep fascia of the neck is opened, the anterior border of the sterno-mastoid is defined, and the muscle drawn backwards with retractors. The digastric muscle is then defined with the finger or a dissector, and the spinal accessory nerve is seen coming from beneath it on its way to perforate the sterno-mastoid. If there is any difficulty in finding the nerve, the surgeon should feel for the transverse process of the atlas and the nerve will be found immediately over it. As a rule, when using the finger or a dissector in this region, twitching of the sterno-mastoid and trapezius muscles will be

set up whenever the nerve is touched. When the nerve is found, it is hooked up into the wound, and as long a portion as possible is removed. The wound is closed without a drainage tube, and the head is fixed in a moulded collar of gutta-percha.

Resection of the cervical nerves.—In order to paralyse the deep rotators of the head the posterior branches of the first, second and third cervical nerves should be divided. For this purpose Keen advises the following operation :—

A transverse incision is made about half an inch below the level of the lobule of the ear, commencing at the middle line posteriorly and extending forwards for about three inches. We prefer to raise

a flap as shown in Fig. 20, as this gives more room. The trapezius muscle is divided transversely and turned up. The surgeon then looks for the great occipital nerve as it leaves the complexus and enters the trapezius; the nerve emerges from the former muscle about half an inch below the incision. The complexus is then divided transversely on a level with the nerve, and by careful dissection the latter is followed downwards

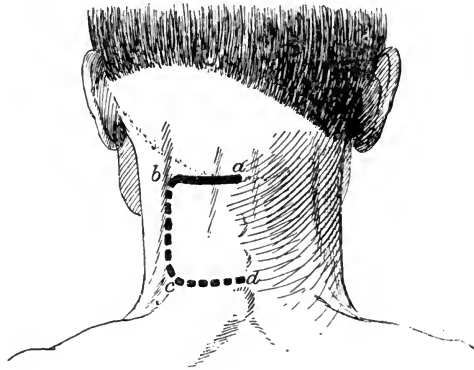


FIG. 20.—INCISION FOR RESECTION OF THE POSTERIOR BRANCHES OF THE CERVICAL PLEXUS. The thick line *ab* is Keen's incision; *abcd* shows the flap recommended in the text.

until its origin from the posterior division of the second cervical is reached. A portion of the posterior division of this nerve is then removed. The obliquus inferior muscle is next identified, and the sub-occipital nerve—which is seen immediately above the muscle—is followed back towards the spine. The nerve leaves the spinal canal between the occipital bone and the posterior arch of the atlas, and lies beneath the vertebral artery; it then enters the sub-occipital triangle, which is bounded by the obliquus superior and inferior and the rectus capitis posticus major. About an inch lower than the sub-occipital nerve, and beneath the complexus, the external branch of the posterior division of the third cervical nerve which supplies the splenius will be found. Portions of both these nerves are removed.

CICATRICIAL DEFORMITIES.

Severe deformity is frequently met with as the result of cicatricial contraction after extensive burns; these cicatrices may draw down the

skin of the neck, bind down the chin, or pull the head to one side and produce a condition closely resembling torticollis.

TREATMENT.—This does not differ from that of cicatrices after burns elsewhere. Division and removal of the cicatrices and fibrous bands, followed by skin-grafting or, if necessary, plastic operations, should be adopted, and these have been fully described (see Vol. I. p. 157, and Vol. III. pp. 488–503). It is possible that good results may also be obtained by cataphoresis with chlorides in these cases (see *B.M.J.*, 1912, vol. ii. p. 488); zinc ionisation has also been spoken well of, but care must be taken lest it produces ulceration.

INJURIES.

CUT-THROAT.

These may be either suicidal or homicidal; in the latter case the structures are generally more extensively damaged than in the former, and it is in them especially that wounds of the important vessels and nerves of the neck most frequently occur. In suicidal cases the chief damage is as a rule inflicted on the left side, but the sterno-mastoid by contracting frequently protects the large vessels from injury. The extent and situation of the wound varies considerably. Usually the incision runs across the thyro-hyoid membrane or just above the hyoid bone. In suicidal cases it is rare for the trachea itself to be opened; the thyroid cartilage may, however, be cut through. It is rare for the carotid artery or the internal jugular vein to be injured; the bleeding usually comes from veins—such as the facial, superior thyroid, and lingual.

It is most convenient to divide cases of cut throat into those in which the air-passages are not implicated and those in which they are involved.

Wounds not involving the air-passages.—Wounds through the thyro-hyoid membrane or above the hyoid bone do not necessarily implicate the air-passages although, when carried deeply, they may do so. When the incision passes through the thyro-hyoid space, the base of the epiglottis may be cut across, the glottis injured and obstruction to respiration produced, either at once or later on from oedema. In this case also there may be free bleeding from the lingual or superior thyroid vessels. The superior laryngeal nerve may also be divided, and in this, as well as in the next group of cases, the blood may pass down into the trachea and actually choke the patient. When the wound is above the hyoid bone, part of the epiglottis may be severed and the pharynx opened, but in that case there is not necessarily any communication with the larynx or trachea. If there is a deep wound above the hyoid bone there may be very free bleeding from the lingual or facial vessels, and the tongue muscles may be cut through

to such an extent that the organ may fall back over the aperture of the larynx and lead to death from asphyxia.

Wounds involving the air-passages.—Wounds of this kind are much more serious on account of the immediate and remote complications which may follow them. These chiefly arise from hæmorrhage, but also from division of important nerves.

When the wound of the air-passages runs through or below the thyroid cartilage the oozing is generally free, and there is great risk of rapid asphyxia from the entrance of blood into the air-passages. Should the trachea be completely divided, the risk of asphyxia will be still greater, as the interference with respiration is then due not merely to the entrance of blood, but to actual displacement of the two halves of the trachea. The œsophagus and the recurrent laryngeal nerve are also frequently injured in these cases, and the carotid artery may be divided.

Amongst the later *complications* may be mentioned septic infection of the wound, leading to diffuse cellulitis of the neck extending into the mediastinum, and bronchitis and broncho-pneumonia, the latter being especially apt to occur, as the patient is often in a low state of health at the time of the self-inflicted wound. Among the less frequent *sequelæ* are emphysema of the neck, an ærial fistula, laryngeal stenosis, or paralysis of one vocal cord following division of the recurrent laryngeal nerve.

TREATMENT.—**When the air-passages are not implicated.**—The main essentials are to arrest the bleeding, and disinfect and suture the wound. The bleeding is usually slight when the air-passages are not opened, because the incision does not extend deeply. When, however, the wound has been made with a sharp-pointed knife thrust deeply into the neck, there may be serious hæmorrhage; under such circumstances, firm digital pressure must be applied to the bleeding point. The best way to do this is to make an assistant thrust his thumb firmly into the wound over the source of the bleeding, placing the fingers and palm of the hand over the back of the neck, and press strongly backwards. While the pressure is maintained the wound is enlarged or its edges retracted, and all blood-clot removed. When the bleeding has thus been temporarily checked, the wound is disinfected, and any bleeding from the smaller vessels can be arrested; if one of the larger trunks is injured, it will be necessary to extend the incision over its course, and the assistant then compresses the vessel above and below the bleeding point, so that a ligature can be applied on each side of it.

In many cases it will be necessary to infuse the patient with saline solution, as the amount of blood lost may be very great. This should be carried out immediately the surgeon is satisfied that the compression of the bleeding spot is effectual. The salt solution should be introduced into one of the veins of the arm (see Vol. I. p. 112), and as soon as the canula has been tied into the vein and the infusion started, its administration should be taken over by an assistant or a nurse, whilst the surgeon

proceeds with the treatment of the wound. When the vessels have been tied, the condition of the nerves must be investigated, and if any have been divided, they should be sutured if possible. If the base of the epiglottis has been cut across, it should be fastened in position by two or three catgut stitches. The soft tissues connecting the hyoid bone and thyroid cartilage should then be sutured as accurately as possible; when the incision is higher up, the muscles of the base of the tongue must be united. If the wound has penetrated the pharynx it is well to insert a small drainage tube; if not, a tube is not necessary.

When the air-passages are involved.—The following points have to be considered: The arrest of hæmorrhage, the prevention of asphyxia, the treatment of the opening into the air-passages, and the measures

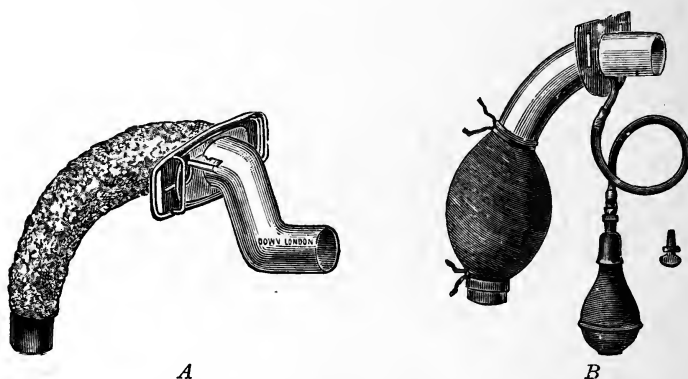


FIG. 21.—HAHN'S AND TRENDLENBURG'S CANULE. *A* is Hahn's tube, which is packed round with sponge. *B* is Trendelenburg's, in which the blocking of the trachea around the tube is done by an inflation apparatus.

necessary to avoid subsequent complications such as cellulitis and broncho-pneumonia.

When the patient is first seen, the two most urgent points to be attended to are the *arrest of hæmorrhage and the prevention of asphyxia*. If the respiration is embarrassed, either from the passage of blood down the air-passages or from obstruction to the larynx by the tongue falling back, the first thing is to apply firm sponge pressure to the wound so as to arrest the bleeding temporarily, and then to open the trachea. As soon as this has been done, the patient's head should be lowered, and the opening in the trachea held wide apart so as to facilitate the escape of blood; this may be further aided by tickling the trachea with a feather. When the clots have been coughed up, a tracheotomy tube should be introduced—and this should be a Hahn's (see Fig. 21, *A*) or a Trendelenburg's tube (see Fig. 21, *B*), if one is at hand—so as to shut off the air-passages and prevent the further entrance of blood, whilst the surgeon is attending to the wound. Should neither of these tubes be

at hand, the trachea should be packed firmly above the ordinary tracheotomy tube either with a small sponge attached to a silk thread or with a long strip of gauze, one end of which is left hanging well out of the wound, so that it cannot be sucked into the trachea. As an additional precaution, it is well to tie a long silk thread to this end of the packing and secure this to forceps.

Attention is next directed to the arrest of the hæmorrhage, and what has already been said with reference to wounds not implicating the air-passages applies equally to these cases. Care must be taken that the disinfectant solutions do not run into the trachea.

The treatment of the wound in the air-passages.—When tracheotomy has been performed, the original wound of the trachea or larynx may be completely closed after it has been disinfected. When the incision runs through the larynx itself, an examination must be made to see whether the vocal cords have been injured, and if so, the divided structures must be accurately sutured; the cartilages are then united by catgut sutures. When the trachea is partially divided, one or two stitches usually suffice to keep the cut ends in apposition; should the tube be completely divided, three stout stitches, one central and anterior, and one on each side, should be employed; a few fine stitches between these will complete the apposition.

After the opening into the air-passages or the pharynx has been completely shut off, the divided structures in the neck are sutured layer by layer, and the skin wound is closed, a drainage tube being inserted at each angle of the wound, lest the wound should become septic. The Hahn's or Trendelenburg's tube should be removed and an ordinary tracheotomy tube substituted for it; if packing has been introduced, it should be taken out.

When tracheotomy has not been performed, the question of closing the opening into the air-passages will depend largely upon the nature of the injury. Should this be extensive and should the wound be closed in the manner just described, considerable emphysema is likely to occur, and in addition there may be œdema of the glottis or even hæmorrhage into the larynx causing considerable embarrassment to respiration; septic pneumonia is also likely to follow. Hence we strongly recommend that tracheotomy should be done in all cases of cut throat involving the air-passages, and a tracheotomy tube introduced; if this is done, the wound in the air-passages may be closed without hesitation. The use of the tracheotomy tube is still more important when the superior laryngeal nerve has been wounded, because the resulting anæsthesia of the glottis hinders the patient from coughing, and food or septic discharges may pass into the air-passages and give rise to a very fatal pneumonia. In these cases a Hahn's or Trendelenburg's tube should be used, and should be changed twice daily.

The wound is dressed in the usual manner, and at the end of the

operation it is advisable to infuse some saline solution, followed if necessary by subcutaneous injections of strychnine and digitaline (see Vol. I. p. 112) to combat the shock, which is often profound.

When the trachea is injured and the larynx has escaped, a tracheotomy tube may be dispensed with if the margins of the wound in the trachea can be accurately sutured. But in such cases the superficial parts should be left open and a drainage tube introduced down to the site of the injury to permit the escape of air and blood.

After-treatment.—The patient should be put to bed with the head bent well forward on to the sternum, so as to take off all tension. The head may be flexed by a large, firm pillow beneath it, and prevented from rotating by sand-bags on each side. If, however, the patient is restless, a firm bandage may be applied around the head, from the front of which long strips pass down to be fastened to the foot or sides of the bed. For the first few hours, at any rate, it is advisable to tie the patient's hands to the sides of the bed, and the case must be watched night and day to restrain restlessness and particularly to see that the bandages are not torn off. A thin layer of gauze wrung out of warm water and sprinkled with terebene should be placed over the orifice of the tracheotomy tube, and fresh terebene or eucalyptus oil should be dropped on it from time to time so as to keep up a constant antiseptic inhalation.

The administration of some sedative, such as bromide of potassium and chloral, or the hypodermic injection of hyoscine hydrobromide (gr. $\frac{1}{150}$) is generally necessary on account of the patient's restlessness; morphine as a rule is objectionable as it increases rather than diminishes this. As much nourishing food as possible should be given and, unless the patient be extremely weak, it is well to employ rectal feeding for the first few days (see Vol. IV. p. 257). As the patient begins to recover, food may be administered by the mouth, but the question whether this may be given in the ordinary way or whether a stomach tube should be used will depend largely upon the conditions present. When the superior laryngeal nerve has been injured, or when there is extensive damage about the base of the tongue, feeding should be carried out through a stomach tube and great care must be taken to see that the tube does not pass into the larynx. Should there be any doubt on the point, as there may be when a tracheotomy tube has not been used, it is well to run a few drops of boric lotion through the tube after its introduction and before food is given; should the tube pass into the air-passages, coughing will be at once excited, and no harm will be done by the introduction of the boric lotion.

Of Complications.—*Septic pneumonia.*—Should this affection set in, the outlook is very grave; the treatment should be conducted on medical lines, and will consist mainly in the administration of concentrated nutritious food and free stimulation by alcohol, ether, or

strychnine. The patient should be propped up in the sitting position, and large jacket-poultices applied to the affected side of the chest. Oxygen inhalations will be required if there is much embarrassment of respiration.

Cellulitis of the neck.—Free incisions must be made where necessary, but in planning them and in arranging the dressing, care should be taken to minimise the risk of entrance of septic material into the air-passages.

INJURIES TO THE VESSELS AND NERVES.

Wounds of the large veins of the neck are of importance, partly on account of the hæmorrhage, but mainly of the risk of the entrance of air into the vein. This subject is dealt with in Vol. II. p. 144.

Wounds of the large arterial trunks are of course followed by immediate death if the vessel is completely or extensively divided. A false aneurysm, an aneurysmal varix, or a varicose aneurysm may follow when the vessel is punctured and the skin wound closed, or a true aneurysm may result when the wall of the vessel is simply contused. The occurrence of aneurysmal varix and true aneurysm following bruising of the vessel wall has been noticed in a number of cases in which the wounds have been caused by high velocity bullets.

Injuries of the nerves of the neck may follow wounds or violent blows. The most important of these nerves is the *vagus*; if this is wounded accidentally, the injury is generally accompanied by fatal damage to the vessels. The matter is different however when the *vagus* is injured in the course of an operation, and it is remarkable that the removal of a large portion of the *vagus* on one side does not necessarily prove fatal, nor indeed does it seriously inconvenience the patient. Should both pneumogastrics be divided, however, the patient usually dies of pneumonia. The division of one *vagus* is followed by paralysis of the vocal cord on that side as the result of the paralysis of the recurrent laryngeal nerve.

Among other nerves which may be injured is the branch of the *spinal accessory* which runs from the sterno-mastoid to the trapezius. After piercing the former muscle a little above its centre it runs obliquely downwards and backwards to the under-surface of the trapezius, which it reaches at about the junction of the middle and lower third of the muscle. This nerve is apt to be injured in the removal of glands from the posterior triangle. The patient then suffers from dropping of the shoulder and difficulty in shrugging it, and there is often a good deal of pain and aching about that shoulder and the side of the neck. Hence an attempt should always be made to find and bring the ends into apposition, though this is a delicate and difficult proceeding on account of the small size of the nerve.

Injuries to the *brachial plexus* may follow violent blows, and are especially common when the blow is delivered in a downward direction or when the arm is violently pulled. According to the particular portion of the plexus injured there will be various paralyses of the upper arm. The plexus may also be pressed upon by callus or by cicatricial tissue, and this may occur after the passage of a bullet. The *cervical plexus* may also be damaged, although much more rarely.

Birth palsies are due to traction on the plexus during the delivery of the infant. In some cases they may be due to the direct pressure of the accoucheur's fingers. The affection is generally unilateral. The earliest symptoms are pain and tenderness in the supraclavicular region and loss of power in the arm. The position of the arm will vary according to the extent of the paralysis.

Post-anæsthetic paralysis is not uncommon. This occurs, as a rule, in patients in whom the arms are kept abducted, externally rotated, or raised above the head during the operation, and is probably due to overstretching of the brachial plexus. In some cases it may be caused by the nerves of the upper arm being stretched over the head of the humerus, and sometimes to the pressure of the arm against the edge of the table. The lesion is an incomplete one and the prognosis is good.

The **thoracic duct** is another of the important structures in the neck which may be injured either accidentally or during an operation. This subject is dealt with in Vol. II. p. 32.

TREATMENT.—Of wounded vessels.—We have already dealt fully with the treatment of injuries to arteries and veins and their sequelæ (see Vol. II.). The remarks made there apply to similar injuries in the neck.

Of injuries to the nerves of the neck.—The treatment of nerves that have been divided in the neck is exactly similar to that required for injured nerves in other regions. If the nerve is divided during the course of an operation, the divided ends can usually be seen easily, and if they are of any size, they should be united by sutures in the usual manner (see Vol. II.). When the operation has to be done for an old-standing injury, the difficulties may be very great owing to adhesions and the presence of scar tissue.

Of injury to the brachial plexus.—The brachial plexus may be exposed in the neck by opening the lower part of the posterior triangle. This is best done by making a curved transverse incision (see Fig. 22), commencing in front of the posterior border of the sterno-mastoid muscle and running backwards across the posterior triangle to the margin of the trapezius. The extremities of the incision may be carried upwards so as to make a flap which is dissected up; the deep fascia is divided and the omo-hyoid muscle exposed. In the upper part of the wound care must be taken not to injure the spinal accessory nerve as it runs back to the trapezius. The upper border of the omo-hyoid muscle is defined and

freed and the muscle is pulled well downwards or upwards as the case may be, and then the large trunks of the brachial plexus will be exposed. It may however be necessary to divide the clavicle if it is necessary to expose the lower part of the plexus. The nerves can then be traced up to their respective points of exit from the spine, the damaged portions identified, and suitable means adopted for the repair of the injury (see Vol. II. p. 116). The wound is closed without a drainage tube. The limb must be fixed to the side with the forearm flexed, care being taken that the plexus is not dragged on.

Post-anæsthetic paralysis recovers without operative treatment. Galvanism and massage are the most effectual methods.

Birth palsies should be treated from the earliest possible moment by bandaging the limb to the side, with the forearm flexed and supinated so as to relax the muscles. Massage should be applied daily. The electrical reactions should be tested at the end of three months under an anæsthetic and they will show whether regeneration of the nerve has commenced or not. In a large proportion of cases spontaneous recovery takes place; if it does not, operation should be undertaken as soon as the general condition of the infant will permit, and a torn nerve sutured or cicatricial pressure relieved if possible.

Of injury to the cervical plexus.—

The cervical plexus may be exposed by an incision running for about three inches along the posterior border of the sterno-mastoid muscle from immediately below the mastoid process; the lower part of the incision must be carefully deepened so as to avoid damaging the posterior branch of the spinal accessory nerve. The lesser occipital nerve is seen as it winds round the posterior border of the sterno-mastoid, and the plexus can be exposed by defining and tracing it back, after separating and pulling the sterno-mastoid well forward. The cervical plexus scarcely ever requires to be exposed on account of injury, but the operation may be necessary for persistent neuralgia after injury.

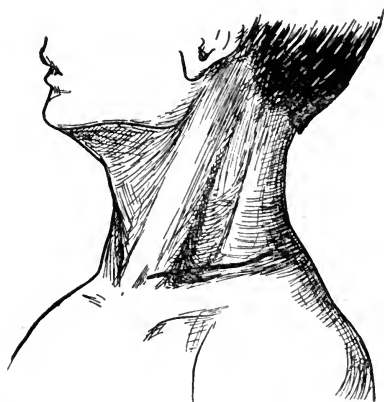


FIG. 22.—INCISION TO EXPOSE THE BRACHIAL PLEXUS.

RUPTURE OF THE STERNO-MASTOID MUSCLE.

Partial or complete rupture of this muscle is rare in adults, but is not uncommon in the newly-born, in whom a swelling is often found over the

centre of the muscle, which has all the characters of a hæmatoma and which is probably due to damage during delivery, especially in cases of breech presentations. The condition is mainly of importance because it is very apt to be followed by wryneck (see p. 73).

The swelling usually subsides in about five or six weeks without any treatment. It will be necessary to take appropriate measures to treat wryneck should that condition (see p. 75) occur.

INFLAMMATORY AFFECTIONS.

Boils and carbuncles (see Vol. II. p. 4) are not infrequently met with on the back of the neck, particularly about the level of the collar where the neck is being constantly rubbed. Deeper seated suppurations also occur, and the very severe form known as Ludwig's angina (see Vol. IV. p. 115) is not at all uncommon.

Suppuration in the cervical glands is dealt with on p. 91.

Chronic abscesses in the neck are practically always associated with tuberculous enlargement of the lymphatic glands or with spinal disease. These are referred to on p. 94.

Retro-pharyngeal abscesses, both acute and chronic, are fully described in Vol. IV. p. 143.

TUMOURS.

New growths may occur in connection with various structures in the neck, such as the skin, muscles, glands, fasciæ, or bones.

LIPOMA.

The neck is one of the commonest seats of lipoma and in this situation it is met with either as a definite encapsuled tumour or as a diffuse lipoma.

The diffuse lipoma is frequently met with, and forms large fatty masses on each side of the nape of the neck, beneath the chin, or just above the clavicles; sometimes the entire neck may become affected. The condition steadily increases, but rarely causes any trouble beyond the deformity, although in some cases there may be a good deal of neuralgic pain.

TREATMENT.—It may be advisable to remove portions of the *diffuse tumours*, either on account of pain or to improve the patient's personal appearance; but the operation is not very satisfactory, as it is exceedingly difficult to dissect away all the newly formed fat, and unless this can be done there is a great tendency to recurrence. It is fairly easy to distinguish between the newly formed and the normal fat by the greater

denseness of the former ; but the diffuse lipoma possesses no capsule and it is very difficult to make sure that all has been taken away. *The encapsuled variety of lipoma* is shelled out as in other situations, and recurrence should not take place.

Other tumours, such as fibroma, myxoma and sarcoma, occur in the neck. Cysts are also met with, and the most common, the branchiogenic cyst, is described on p. 69 ; enlarged bursæ about the hyoid bone are referred to on p. 125. Cysts of the thyroid or an accessory thyroid are described in Chap. IX. *Cysts containing air* are sometimes found ; they are usually diverticula from the pharynx, in which the opening is too small to admit food but allows the entry of air, so that the pharyngeal pouch becomes distended and forms a tympanitic swelling in the neck which is easily emptied on pressure. The treatment is the same as for a pharyngeal diverticulum (see Vol. IV. p. 120). *Dermoid cysts* sometimes occur in the middle line in connection with imperfect fusion of the two sides of the neck.

CYSTIC HYGROMA.

This is a lymphangioma undergoing cystic dilatation and is always congenital. The tumour is a lobulated multilocular mass, often of great size and fluctuating in parts ; there are frequently a number of cysts which are shut off from each other. It is situated beneath the deep cervical fascia, most frequently in the submaxillary region or the lower part of the posterior triangle. The lymphatic vessels in the vicinity are usually dilated.

TREATMENT.—The treatment formerly recommended—namely, injection of iodine into the cysts, is of little use when the tumour is multilocular, as it generally is. On the other hand, incision into the lymphangiomatous mass often leads to an acute attack of inflammation which, if septic, may be fatal. Even with the greatest care, bacteria may get into the wound and, although they would do no harm in the ordinary tissues, they may develop in the lymphatic spaces and cause serious inflammation. Therefore, unless the tumour is increasing rapidly or is causing serious symptoms, it is well not to interfere, especially in young children in whom restlessness renders it difficult to keep on efficient dressings. If possible, the tumour should be left alone until the patient has grown up.

In operating for the removal of the tumour, care should be taken to carry the dissection well beyond it in all directions, so as not to leave any of the dilated lymphatics behind. No special rules can be given for these operations. They are often exceedingly tedious and difficult, as the mass spreads between various important structures in the neck and adheres to them. A drainage tube should be inserted after the operation and left in for some days, as there is always a quantity of lymph and serum exuded into the wound.

MALIGNANT TUMOURS

Primary *carcinomata* of the neck occurring without any evident lesion of the mucous or cutaneous surface usually develop in connection with a branchiogenic cyst or cleft. They are deeply placed and very adherent to adjacent structures. They grow rapidly and sometimes simulate an abscess, the skin becoming red and œdematous over them. The fluid is of a dirty grey colour and often contains large, soft, white masses composed of squamous epithelial cells.

In most cases the tumour cannot be extirpated, and partial excision leaves a foul fungating mass in the neck. The greatest care should be taken in the diagnosis, because a fungating ulcer will rapidly form if the tumour is mistaken for an abscess and incised.

Endotheliomata sometimes occur primarily in the neck; the most frequent seat of origin is the carotid body. The tumour forms a soft oval-shaped mass situated beneath the sterno-mastoid muscle and about the level of bifurcation of the carotid artery. It can be moved laterally, but not in a vertical direction, owing to its intimate connection with the carotid sheath; it may be very vascular. Removal is difficult owing to its close connection with the large vessels.

CHAPTER VIII.

THE SURGICAL AFFECTIONS OF THE CERVICAL GLANDS.

THESE are among the most common and the most important affections of the neck and a variety of conditions may be met with. Among these may be mentioned acute adenitis, tuberculosis, syphilis, secondary carcinomatous or sarcomatous disease, and primary lymphadenoma or lymphosarcoma.

ACUTE ADENITIS.

Acute adenitis often follows inflammation or ulceration of the mucous or cutaneous surfaces drained by the glands and may pass off when the infection is at an end. Enlargement of the cervical glands in association with tonsillitis or other inflammations about the throat and mouth, and also after boils or pediculi, is extremely common; but the adenitis rapidly subsides when the primary source is cured unless pyogenic organisms have reached the gland in considerable numbers or unless the condition is tuberculous.

If suppuration occurs, the symptoms vary according to the situation of the gland or glands affected, and may be very acute. As a rule one or two glands only are implicated and the pus forms first in the interior of the gland, but suppurative peri-adenitis soon occurs, and is indicated by induration, redness, and oedema of the skin and tissues around.

TREATMENT.—In the ordinary *acute non-suppurative adenitis* attention must be directed to the primary trouble, but little need be done as regards the glands beyond relieving the pain, applying hot fomentations frequently, and keeping the head and neck at rest. When the acute stage has passed off, the application of glycerinum belladonnæ to the surface is sometimes useful.

When suppuration occurs, the abscess must be opened. It is not sufficient, however, to make an opening into a suppurating gland and introduce a tube. The pus in the early stage is often deeply seated in

the enlarged gland, while in more advanced cases it may be outside the capsule, and other smaller foci may be present in other parts of the gland which will keep up the inflammation and prevent healing. The best plan is either to apply fomentations, in the first instance, until suppuration has occurred practically throughout the affected gland, as evidenced by free fluctuation, and then to open it, or else to remove the suppurating gland altogether. If an incision is made into a gland supposed to be the seat of suppurative adenitis and if only very little or no pus is found, the best plan is to proceed at once to enucleate the gland and leave a drainage tube in the wound.

When opening abscesses in the neck care must be taken not to damage important structures, and it is here that Hilton's method (see Vol. I. p. 28) is particularly applicable; the parts are always so matted by inflammation that important structures may be injured if the knife is employed to open up the deeper parts. The incision should be small and transverse in direction.

Persistent enlargement of glands after an inflammatory attack is not uncommon; in many cases long continuance of the enlargement indicates a tuberculous infection.

TUBERCULOSIS.

This is the commonest affection of the cervical glands, and is most frequent in those in the anterior triangle; the tubercle bacilli probably enter in most cases from the mouth or throat.

Although it is probable that the bacilli frequently come from a local source about the tonsil or throat, this does not seem to be the invariable sequence of events. In some cases, at all events, the adenitis which follows a local infection in the mouth or throat is a simple one, and it is probable that the subsequent invasion of tubercle bacilli comes from the blood. For example, an acute inflammation about the throat or mouth may lead to a cervical adenitis, which, not being infected with pyogenic organisms, does not go on to suppuration; as the primary irritation ceases, the gland becomes smaller. But in a susceptible patient with tubercle bacilli present elsewhere in the body, the bacilli may be deposited in this inflamed and weakened gland, which may again enlarge and become tuberculous. This is also probably the mode of infection of those glands which enlarge after sores on the head.

The primary lesions which give rise to enlargement of the glands are very various. Perhaps one of the most frequent is carious teeth, and it has been presumed that the bacilli enter the tissues above the root of the tooth and subsequently reach the glands. Nevertheless, when the tooth is removed the cavity generally heals completely without any tuberculous development—a point in favour of the view just enun-

ciated. Tuberculous cervical glands frequently follow enlargement of the tonsils, which in some cases are found to be tuberculous; in many instances, however, even in phthisical patients, neither bacilli nor tuberculous tissue are found in the enlarged tonsils, so that there is no definite proof that the bacilli gained entrance in this way.

Enlargement of the glands is most common in the upper part of the anterior triangle of the neck. When the anterior triangle is affected, the infection of the glands spreads backwards beneath the sternomastoid muscle, and upwards and downwards along the course of the vessels.

There are great variations in the number and size of the glands affected, in the rapidity and progress of the disease, and in the tendency to softening and abscess formation. From the point of view of treatment it is well to divide the cases met with into five large clinical groups.

1. The glands may remain small and firm or elastic, and are not sufficiently large to produce deformity and have no marked tendency to undergo softening. These glands are freely movable and there is no peri-adenitis matting them to the surrounding tissues. Other glands slowly become involved, but they tend to become gradually smaller unless some acute intercurrent mischief, such as sore-throat, influenza, or one of the exanthemata, occurs. After one of the intercurrent affections just mentioned, sudden increase in the size of the glands may take place, and the disease may run a more acute course.

2. In other cases the glands enlarge either steadily or by fits and starts until they attain a large size and many glands are involved, so that marked deformity is produced. This condition is generally bilateral, although it is often more extensive on one side, and it may persist for a long time without suppuration, the glands remaining, meanwhile, mobile and discrete. The disease generally spreads by direct continuity from the neck to the axilla. The patient is usually of a pasty complexion and the general health is poor. The glands are converted into cheesy masses, some of which show calcareous nodules; others may appear normal to the naked eye, but under the microscope are found to contain tubercles.

3. In the third variety the disease is more acute and is prone to end in suppuration. The affection may be limited to a small group of glands, but these enlarge rapidly. Peri-adenitis sets in, and the glands become matted together and adherent to the adjacent tissues; suppuration occurs early. Abscess after abscess may form if no operative treatment is employed, and numerous sinuses and unsightly ulcers often occur; these sinuses may burrow in various directions.

4. When the patient first comes under notice, there may be advanced suppuration in the glands, but the abscess may not have burst externally. An abscess of this kind may be situated either beneath the deep fascia—

in which case it is fairly large and may occupy only a portion of the enlarged glandular mass—or it may have perforated the fascia, forming a subcutaneous abscess with thinned and reddened skin over it. In some cases the abscess may be limited to one gland.

5. Finally an abscess may have formed and burst spontaneously or have been opened, and sinuses remain. These sinuses may be numerous or single. They lead down through a hole in the fascia to the remains of the glandular mass, and at the bottom of the sinus there is generally a quantity of cheesy and often calcareous material and broken-down gland tissue that cannot escape. The skin around the orifice of the sinus becomes the seat of a tuberculous ulcer.

TREATMENT.—(a) **Medical.**—A good many cases do well without operation, the enlargement of the glands becoming gradually smaller and ultimately disappearing, or slightly enlarged glands remaining quiescent. The medical treatment consists in placing the patients under the best hygienic conditions, in preventing excessive movement of the part, and in the administration of various remedies. The patients should be sent to the country and live as much in the open air as possible. The fashion is to send them to the seaside, and undoubtedly sea air is most beneficial in many cases; some patients do better however in an inland situation. The temperature of the place chosen is a point of importance.

All decayed teeth must be stopped or removed, and other sources of irritation—such as enlarged tonsils and adenoids or sores on the face—must be dealt with before sending the patient away. The head should be placed at rest as far as possible; in most cases it suffices to put a mass of cotton-wool round the neck and fix it on with a firm bandage. In active children, however, in whom the glands are enlarging, it is well to mould a piece of poroplastic material to the shoulder, neck, and side and back of the head on the affected side, so as to fix the head. Some surgeons keep their patients in bed or in a spinal carriage, with a moulded splint or collar applied to the head and neck. We think that when such treatment as this is thought desirable, it would probably be better to adopt operative measures at once.

The usual *drugs* employed are cod liver oil and syrup of iodide of iron. Cod liver oil or one of the emulsions on the market may be given in teaspoonful doses two or three times a day during the cold weather, provided it does not upset the digestion; if it does, it is inadvisable to persevere with it. The food should be as digestible and nourishing as possible, and plenty of fresh milk and cream should be given. Arsenic is valuable in some cases and is given in the form of Fowler's solution commencing with 1 minim doses and gradually increased. Injections of tuberculin (see Vol. I. p. 522) should be given, commencing with very small doses gradually increased. In some cases tuberculin does good, but its action is slow and it cannot be substituted for operative treatment in cases in which the latter is otherwise desirable. Sometimes

it appears to cause abscess formation and therefore its effects must be closely watched, and, if pus forms, operative measures must be adopted. Local applications are of little value, and friction is deleterious. Good results may follow X-ray treatment.

The patient must be carefully watched, as medical treatment alone should not be persisted in when it becomes evident that suppuration is taking place. When that is the case, the sooner the glands are excised the better, because delay only increases the difficulty of the operation owing to the matting of the tissues from the inflammation around. Patients should never be sent off into the country to come back in six or eight months' time; they should be seen at fairly frequent intervals such as once a month, and operative measures should be adopted on the earliest sign of the gland breaking down.

When the glands remain small and hard, do not produce much deformity, and betray no marked tendency to softening, the patient may be watched for a time under appropriate medical treatment (*vide supra*), and there is no pressing necessity for operative interference, unless the disease becomes active. As long as the glands remain quiescent, there is probably no great danger of dissemination of the disease.

The following are the chief indications for operation :—

1. When there is an enlargement of the glands causing a noticeable swelling, or when the affected glands are numerous and the disease is extending, operation is generally required. When the disease has reached this stage, absorption seldom occurs, and not only does the unsightly deformity remain, but the disease tends to spread to other glands, and the ordinary medical measures seem to be of little value. Here the only possible operative procedure is excision; scraping would be futile as numerous glands are affected, and besides it is impossible to remove the disease effectually with a spoon. Scraping can only remove the softened areas of disease and, unless the gland has completely broken down, large areas of infected gland tissue will be left and recurrence will at once take place. Not only must the enlarged glands be taken away, but also all the fat and small glands in the infected area. Should the glands beyond the area of the first operation enlarge subsequently, they also must be removed. When both sides of the neck are affected, removal of the glands on one side is sometimes followed by considerable improvement in those on the other side, and it may be unnecessary to operate on the latter if efficient medical measures are subsequently employed.

2. When the glandular trouble is very acute and leads rapidly to adhesion to the surrounding structures and to the skin, it is very important that operative measures should be employed before a definite abscess has formed. While in these cases the glands sometimes subside under careful treatment, they rapidly break down, as a rule, and fairly extensive suppuration occurs; hence they should be closely watched for this

complication. It is very seldom that one gland alone is affected, and as scraping only deals with the particular gland penetrated by the instrument, it is of no use in these cases. Hence, under these circumstances, we advise complete removal of the infected area by excision.

3. When suppuration is occurring in the glands, the cases may be arbitrarily divided into three groups: (a) The abscess, after bursting through the fascia, may form a comparatively limited swelling beneath the skin. In these cases complete excision of the gland and the abscess may be performed, in the manner to be described immediately, an oval piece of the skin being removed with the abscess. (b) The abscess in the gland may have burst through the fascia and have formed a large swelling beneath the skin, which is thinned over it. Here the operation advised above—namely, complete removal of the abscess, the glands, and the portion of skin affected—would entail a gap that it would be difficult to close and the scar of which would be very unsightly. It is therefore probably best merely to open the abscess in the first instance, and three or four weeks later, when the skin has recovered and merely a sinus is left, to treat the case as one falling under the next heading, namely, that of tuberculous glands accompanied by a sinus. In some cases in which the suppuration is limited to one gland, it may suffice for a cure to open the abscess and scrape out the gland. When, however, the wound does not heal and fresh glandular swelling appears, the case must be treated as above. (c) An abscess may be present which has not yet perforated the deep fascia. When the affection appears to be limited to one gland, and when this is apparently totally destroyed and a mere bag of pus is present—as indicated by fluctuation throughout the whole of the swelling—it may be worth while to make a small incision into the abscess, evacuate the pus, scrape away all caseous material, inject iodoform and glycerine emulsion, and stitch up the wound. When it can be done, a small transverse incision behind the posterior margin of the sterno-mastoid will suffice, and the resulting scar is practically invisible. This method is however only available in a very few cases, and is useless when a large mass of infected glands is present. Under these circumstances, other glands will generally enlarge very rapidly, and a sinus will form and ultimately the glandular area will have to be excised.

4. When the enlarged glands are accompanied by sinuses, excision is undoubtedly the best method whenever it can be adopted, and it should always be carried out when there are not more than two or three sinuses along the line of the incision necessary for the operation upon the glands. When, however, there are numerous sinuses in different directions, this would involve a number of incisions and the removal of a considerable cutaneous area in order to extirpate the disease completely, and therefore thorough scraping of the sinuses and the glands at the bottom of them, followed by the application of undiluted carbolic acid to the

raw surface, is the best treatment. In some of these cases, treatment by tuberculin and vaccines made from the organisms present in the sinuses may be beneficial if used previous to the operation.

(b) **Operative.**—Two operative procedures are employed—namely, excision and scraping. The aim of excision is to remove not only all the glands enlarged, but also all those in the vicinity of the enlarged mass; to be effectual the operation must be extensive, even in comparatively limited cases. Scraping, on the other hand, only affects the individual gland or glands that are breaking down; whilst others, that may also be affected, are left untouched. It is no doubt true that the latter may subside when the original suppurating gland has been got rid of, and that the disease may thus be cured; on the other hand, it is far more likely that they will enlarge rapidly and necessitate a further operation. This method has its uses, but it ranks far below excision in value, and is only to be recommended in rare instances.

The method of excising tuberculous glands in the neck.—The incision will vary according to the extent and situation of the disease and to other circumstances, but it is well to avoid vertical incisions. The great objection to any scar in the neck that is vertical or almost vertical is that it tends to become broad and unsightly as time goes on, and therefore we generally employ curved incisions, which fall into the natural folds of the neck.

In the case of the upper part of the anterior triangle the incision commences near the posterior margin of the sterno-mastoid on a level with the angle of the jaw, and curves downwards and forwards until it ends close to the larynx, about the level of the hyoid bone (see Fig. 23). The line of the incision should follow the normal folds of the skin. The elasticity of the skin allows of enough retraction to get good access to the glands. Should an abscess be present, the incision must be so planned as to include the thinned skin over it in an oval incision.

When the glandular area requiring removal is very extensive, and both anterior and posterior triangles are involved, the two curved incisions shown in Fig. 23 are very useful, and give scars that are hardly noticeable. The upper one commences behind the sterno-mastoid nearly on a level with the lobule of the ear, and runs obliquely downwards and forwards along the natural crease of the neck to a point about the level of the top



FIG. 23.—INCISIONS FOR REMOVAL OF TUBERCULOUS GLANDS FROM THE NECK. The upper curved incision is for the clearance of the upper part of the anterior triangle; the lower one for the posterior triangle. The two incisions may be used in conjunction in bad cases.

of the thyroid cartilage. By means of this incision practically the whole of the anterior triangle can be cleared out and, in addition, the upper part of the posterior triangle is rendered quite accessible. The lower incision runs parallel to the upper, and extends across the lower part of the posterior triangle from the anterior margin of the trapezius to the posterior margin of the sterno-mastoid.

The most scrupulous disinfection of the region must be carried out, as septic infection would be disastrous. The hair is shaved from the ear back to the occipital protuberance when the glands are enlarged at all high up, and a sterilised towel is wrapped around the head so as to keep the hair out of the way of the operator. The neck is extended over a sand-bag, and the head turned well over to the opposite side, and the mouth shut off by covering the side of the face on the affected side with a sterilised towel suspended on a suitable screen.

After the skin, superficial fascia and platysma have been raised both above and below the incision, they are retracted upwards and downwards, the anterior edge of the sterno-mastoid muscle is defined, and the deep fascia is cleared.

The next step is to incise the deep fascia at the lower part of the wound quite close to the edge of the sterno-mastoid, and to define the internal jugular vein. This is, in fact, the key to the operation, as the glands always lie close to the vein and are often adherent to its sheath, and if attempts be made to remove them without previously defining the vein, great trouble may be experienced. The vein is therefore first exposed below the area of glandular enlargement and the sheath divided so that a blunt instrument, and subsequently the finger, can be insinuated between the vessel and the mass of glands, which is peeled off it in the upward direction. Should the vein be very adherent—as may be the case when the glands are much matted together and are suppurating—this procedure may be very difficult, and rupture of the tuberculous mass may occur; under these circumstances it is best to ligature the vein below in two places and divide it between the ligatures. The upper end of the vessel can then be pulled upwards with the enlarged glands and separated easily from the artery and vagus nerve. The loss of the vein apparently makes no difference to the patient, whilst it facilitates the operation and minimises the risk of recurrence.

After the tissues have been cleared for some distance, it is well to define the spinal accessory nerve and preserve it from injury. The nerve runs deep to or through the mass of glands, which can always be dissected off it. It should never be excised on the supposition that the disease has infected it.

The steps of the operation are practically identical with those described in connection with removal of malignant glands from the same situation (see Vol. IV. p. 101)—namely, exposure of the jugular vein as just described, separation of the tissues in front, ligature of the veins passing back to

the mass, exposure and preservation of the spinal accessory nerve, ligature of the jugular vein above and below the mass, if necessary, and complete removal of all fat and glands above the spinal accessory nerve and beneath the upper part of the sterno-mastoid. As much as possible of the fat and glands beneath the muscle lower down should also be removed in one mass; individual glands should not be dissected out.

As is remarked in reference to removal of malignant glands in the neck (see Vol. IV. p. 107), division of the upper end of the sterno-mastoid exposes the region much more thoroughly. This is rarely necessary for tuberculous glands, but when they are very adherent it may help considerably.

It is well to bear in mind that the lowest branch of the facial nerve which runs under the jaw and curves upwards to the angle of the mouth is apt to be adherent to the upper part of the glandular mass, and if this is injured, there is paralysis of the depressors of the lower lip. This can hardly be avoided in some cases, but in our experience the paralysis disappears in the course of two or three months.

When the mass has been removed, a clean dissection of the anterior triangle and the parts underneath the sterno-mastoid muscle should be seen. In some cases, however, glands are present beneath the vessels, and must also be removed. By proceeding in this methodical manner, the chances of recurrence in the anterior triangle are extremely slight, as all the glands are removed. Recurrence may however take place in the posterior triangle lower down, or anteriorly in the submaxillary triangle.

After the operation has been completed and the vessels tied, the divided platysma and deep fascia should be united by fine catgut sutures and the incision is then stitched up with a fine continuous horsehair suture or with a subcuticular horsehair stitch. If the platysma has been sutured, the skin stitch may be removed at the end of five days, but when a subcuticular stitch has been used it may be left for a week. A drainage tube is unnecessary in many cases, but it is advisable to insert one for twenty-four hours when there is a large cavity left.

When sinuses are present.—These cases are usually septic, and therefore it is well to scrape out the sinuses before beginning the dissection, and then pass down each a piece of sponge soaked in pure carbolic acid. The incisions should be so planned that the openings of the sinuses are included in elliptical incisions, and care is taken not to cut across the sinus in the course of the operation; the best way of avoiding this is to pass a probe along the sinus and keep it in position until the entire track has been defined. We have seldom seen infection of the wound occur in these operations; at the same time it is always well to put in a drainage tube for a few days in case infection should have occurred. When a drainage tube is employed, the skin should be perforated behind the sterno-mastoid muscle and the end of the tube brought out there; this allows the

anterior incision to heal, and secures drainage from the most dependent point.

When the *posterior triangle alone* is the seat of the enlarged glands, the main mass is usually situated just above the clavicle. The incision (see Fig. 23) commences a little in front of the posterior border of the sterno-mastoid, just on a level with the most prominent part of the glands, and curves upwards and backwards to the anterior margin of the trapezius. A vertical incision over the centre of the glandular mass may be used when the glands are very numerous and extend high up, but this gives a more conspicuous scar.

An essential point in this operation is to avoid injury to the branch of the spinal accessory nerve which runs across the space to the lower part of the trapezius. This is often very difficult because the glands run along the nerve and may completely surround it.



FIG. 24.—INCISION FOR REMOVAL OF TUBERCULOUS GLANDS FROM THE SUBMAXILLARY REGION.

The first part of the operation consists in detaching the fascia from the posterior border of the sterno-mastoid muscle, paying special attention to the point of emergence of the spinal accessory nerve. After the nerve has been defined in front, a probe is insinuated along it and the tissues divided over this, so that the nerve is bared through-

out its whole extent and may be kept from injury afterwards. The glands generally run beneath the sterno-mastoid muscle below, and are attached to the jugular vein; if the mass is pulled upon, the jugular vein is generally drawn out behind the sterno-mastoid. If this is the case, the vein should be defined above the glandular mass, the sheath divided, and the glands detached. On the right side this is easily done; on the left side the presence of the thoracic duct below must be borne in mind, and also the fact that lymphatic branches run from the glands to the duct, and the latter may be torn if much force is used.

When the glands are situated in the submaxillary region a curved incision is carried downwards from the symphysis of the lower jaw to the hyoid bone, and then backwards along it and upwards to the angle of the jaw (see Fig. 24). In many cases the glands are adherent to the submaxillary gland; every effort should be made to leave this gland intact, but it may be necessary to take it away in bad cases.

There are no special points about this operation ; the facial artery and vein may be cut, but are easily secured.

SYPHILITIC DISEASE.

Enlargement of the cervical glands occurs in primary syphilis when the chancre is situated about the mouth or throat, and it is also common in the secondary stage, the glandulæ concatenatæ being particularly prone to enlargement. Tertiary enlargements of the glands are sometimes met with, forming large masses which are very difficult to diagnose. The treatment is that of syphilis in general (see Vol. I. Chap. XI.).

MALIGNANT DISEASE.

This may be either secondary to disease of the mucous membrane or skin, or primary in the glands themselves. Of the primary diseases lymphosarcoma is the common type, and is fully described in Vol. I. p. 264. Lymphadenoma may perhaps also be reckoned in this group, though its pathology is not yet determined. Among the secondary infections of glands may be mentioned those occurring in connection with malignant disease of the skin of the neck, the upper jaw, the mouth, the tongue, the pharynx, the larynx, and the œsophagus.

TREATMENT.—The treatment of the *secondary glandular affections* of the neck is removal when the extent of the disease permits of it, and this question has been fully dealt with in connection with removal of glands secondary to malignant disease of the tongue (see Vol. IV. p. 101). Lymphosarcoma also can only be dealt with by free excision when this is possible.

With regard to *lymphadenoma*, experience shows that operation is generally futile. Even when the glands affected are few and the removal is apparently complete, it will be found that fresh glands enlarge almost before the wound has healed. On the other hand, some of these cases improve so remarkably during the administration of arsenic that it is better to put the patient upon this drug, commencing with doses of ℥iij of Fowler's solution and gradually increasing it to ℥xv-xx, or more, intermitting it occasionally, and always interrupting the administration if any gastric derangement occurs. The subject is fully referred to in Vol. II. p. 50.

CHAPTER IX.

THE SURGICAL AFFECTIONS OF THE THYROID GLAND.

ATROPHY.

THE thyroid gland may be imperfectly developed or completely absent in infants and then the condition, known as 'cretinism,' results. Atrophy of the thyroid gland is also not uncommon in adults and gives rise to the disease known as myxœdema. Operations in which the thyroid gland is completely extirpated also give rise to myxœdema. That all cases of apparently complete extirpation of the thyroid gland are not followed by this affection, is probably explicable on the view that some part of the gland has been left behind, as even a very small portion may be sufficient to prevent the occurrence of this condition, as is shown by the absence of this disease as a result of the present practice of leaving a portion of the posterior part of the gland in all cases of thyroidectomy. The symptoms and treatment of myxœdema do not properly belong to a surgical work; medical text-books should be consulted.

INFLAMMATORY AFFECTIONS.

ACUTE THYROIDITIS.

Acute inflammation may occur in a normal thyroid or in one which is enlarged from other causes. It may follow injury or may be associated with rheumatism; more frequently it occurs in connection with septic conditions, especially pyæmia. It may also follow acute specific fevers, such as typhoid fever. Inflammation is not uncommon after puncture of a thyroid cyst, or the injection of a goitre when the antiseptic precautions have been insufficient. The inflammation may end in resolution or lead to localised or diffuse suppuration in the gland. An abscess is

most likely to occur when the inflammation follows an injury, an acute specific fever, or general septic disease.

The gland enlarges rapidly and becomes tender, the skin over it becomes red and œdematous, and there may be dyspnœa and considerable interference with swallowing. The patient's general condition is grave, the constitutional symptoms being severe and out of all proportion to the extent of the inflammation. The probability is that this is due in some way to interference with the secretion of the gland. Thrombosis and pyæmia are not uncommon sequelæ of an acute suppurative thyroiditis, and this is not surprising when the extreme vascularity of the gland—particularly its richness in large veins—is considered. There is also a tendency for the pus to make its way into the cellular tissue of the neck or into the trachea or œsophagus. When the abscess is situated deeply in the gland, the difficulty of diagnosis is great, and the patient's condition may be very serious.

TREATMENT.—In the first instance a purge, *e.g.* calomel gr. v, followed by a saline, should be given, and the source of the infection looked for. Where this is due to some local condition, appropriate treatment for its removal should be adopted. When the disease is associated with some general condition, the latter must be treated on ordinary lines. Thus, in rheumatic patients the administration of salicylate of soda is called for; in malarial cases, or those due to typhoid fever or occurring in connection with septic processes, the administration of quinine (in 5- to 10-grain doses every four hours) may be useful.

Locally, four to eight leeches should be applied over the enlarged gland, and these should be followed by hot fomentations to promote bleeding. Large hot fomentations are the best means of relieving the pain and the difficulty in swallowing.

When suppuration occurs—as will be indicated by marked and increasing œdema of the skin, combined with a high temperature and an area of softening—early incision should be practised; great care must be taken to avoid injury to the large venous trunks. The best plan is to open the abscess by Hilton's method (see Vol. I. p. 28), making the skin incision along one of the natural folds of the neck. As the abscess may be deeply placed, the incision must be large enough to enable the surgeon to see what he is doing, and efficient drainage must be provided by means of a large tube. If the pus has formed within an encapsuled tumour (cyst or adenoma) an attempt should be made to enucleate the tumour as well.

The other inflammatory affections of the thyroid gland hardly require notice, as they are excessively rare. **Tuberculosis**, either as part of a general infection or as a localised deposit, may occur in the thyroid gland as elsewhere, and the treatment must be the same as for tuberculous disease in general. **Syphilis** of the thyroid also occurs in the form of a gummatous infiltration of the gland in the tertiary stage. This is of

great interest from the point of view of diagnosis, but the treatment offers no points of special importance, except that tracheotomy may be necessary if there is much interference with breathing; otherwise it should be that of tertiary syphilis elsewhere (see Vol. I. Chap. XI.).

GOÎTRE.

Under this term it is usual to include all enlargements of the thyroid gland which are not of an inflammatory nature. Hence goître is divided into several classes, such as parenchymatous, adenomatous, cystic, exophthalmic, and malignant goître. The pathological condition differs widely in the different cases.

PARENCHYMATOUS GOÎTRE.

There is here a general enlargement of the thyroid gland, involving both its secreting and fibrous structures. In the majority of cases the entire gland is affected, although the enlargement may be more marked on one side or in the isthmus. Sometimes one lobe only is affected, but it is very rare for the isthmus alone to be enlarged. When there is a great difference in size between the lobes, adenomata are usually present in addition to the parenchymatous enlargement: the goître is then often called adeno-parenchymatous.

Goître is endemic in certain regions. In England it is commonest in Derbyshire, where it is known as 'Derbyshire neck.' It is also frequently met with in other parts of this country and is very common in Switzerland. It is not as a rule hereditary, and nothing definite is known as to its causes. At one time it was attributed to the presence of salts of magnesium, calcium, etc., in drinking water. It has also been attributed to the want of iodine in the water, whilst by others it has been thought to be due to a lack of sunshine, to a cold climate, to the drinking of snow-water. A bacterial origin of goître has also been put forward, and an attempt has been made to uphold it by pointing out that drinking-water containing an excess of magnesium and other earthy salts, but free from bacterial contamination, has not affected those who consumed it; whilst the drinking of water in the neighbourhood, containing less saline constituents but highly contaminated with bacteria, has been followed by the development of goître in large numbers of people. Recently, some work has been done which would appear to show that goître is dependent on a bacterial infection derived from the intestinal tract. Animals supplied with water containing fæces have developed goître. The improvement which sometimes follows vaccine treatment against the colon group of bacilli would suggest also the possibility of a bacterial origin of this nature.

The enlarged gland gives rise to a characteristic swelling in the lower part of the neck which moves with the larynx and trachea on deglutition and takes the outline of the portion of the thyroid gland affected. If the enlargement is considerable and both lobes are affected, they may exert lateral compression upon the trachea, sometimes to such an extent as almost to occlude it. This lateral compression produces what is known as the 'scabbard trachea.' In other cases the enlargement may extend down behind the sternum, and the trachea may be compressed between the gland and the spine. As a result of pressure in either of these ways or both combined, the patient suffers from dyspnœa, which becomes aggravated on the slightest exertion. If one lobe only is affected, respiration may not be interfered with, although the weight of a very large tumour may incommode the patient when he lies on his back. In other cases again the enlargement may chiefly affect the posterior part of the lateral lobe and may extend in between the œsophagus and the trachea, causing much discomfort and dysphagia. In these cases the recurrent laryngeal nerve may be compressed and abductor laryngeal paralysis may occasionally result. Long-continued pressure upon the trachea causes atrophy of the tracheal rings, and this is a most important point to bear in mind during operation, as very slight force would then suffice to tear the trachea—an accident of extreme gravity, partly because blood may find its way into the air-passages in large quantity and partly because it is then impossible to keep the wound aseptic.

The amount and nature of the dyspnœa produced in these cases varies considerably, and careful distinction should always be drawn between the dyspnœa due to pressure upon the recurrent laryngeal nerve—in which case there will be aphonia—and that due to compression of the trachea, when there will be stridor both on inspiration and expiration, but no aphonia. The larynx should always be examined with the laryngoscope before operation is undertaken, to see whether both cords move freely, and also whether there is any displacement inwards of the walls of the trachea obstructing respiration.

Parenchymatous goitre is not very uncommon in children; it often increases rapidly about the age of puberty and may cause severe pressure on the trachea leading to great dyspnœa and even sudden death. Hence a goitre in a child should always be carefully watched and treated by medical measures, in the first instance, and operated on if the size of the tumour does not diminish or if it increases.

TREATMENT.—This may be either non-operative or operative, and the choice between the two will depend largely upon the presence or absence of severe pressure symptoms and on the size of the tumour.

(a) Medicinal.—The success of non-operative or medical treatment depends on a proper selection of cases. A tough fibrous parenchymatous goitre of long-standing in an old patient is not likely to be cured, but may, to some extent, be improved by medicines. The most suitable

cases for such treatment are soft goîtres in young people. The patient should, if possible, migrate from a district where goître is frequent ; if it is impossible to do so, all drinking-water should be boiled and filtered and the purity of the water as regards contamination should be ensured. Chief amongst the internal remedies are *iodine and iodide of potassium*, and distinct improvement may follow moderate doses of these drugs ; the treatment should commence with 3-grain doses of the iodide and 3-minim doses of the tincture three times a day, and need seldom be increased beyond 10 or 15 grains and minims respectively. *Thyroid extract* has been administered on the presumption that it would insure physiological rest to the gland, and in some cases it is extremely useful. It should be given in small doses at first, and its effect on the pulse carefully watched. If improvement takes place, it will be evident in three or four weeks, and the treatment should be continued ; if no improvement is evident in that time, this line of treatment should be abandoned. Other internal remedies are not very satisfactory. In very anæmic patients *arsenic and iron* may be of some value, but as a rule they have not much influence upon the affection. Quite recently treatment by *vaccines* of organisms of the colon group obtained from the fæces of the patient has been advocated, but it is too early to speak definitely of the value of this method.

Various methods of *local treatment* are employed. In India the red iodide of mercury ointment is rubbed in thoroughly over the goître, and the neck is then exposed for some hours to the rays of a hot sun ; it is stated that very great improvement has been obtained in this way, but unfortunately the method is quite useless in this country. We have not seen any benefit follow the use of other external applications.

(b) Operative.—The only reliable method of cure is to remove the portion of the gland that is causing the trouble. In the early days of operation upon the thyroid the entire gland was removed, but it was soon found that many of the patients so operated upon suffered from a peculiar disease which was subsequently recognised as surgical myxoedema and which was evidently due to the removal of the gland. It was then found that all that was necessary to prevent this occurrence was to leave a portion of the gland behind. In most cases therefore the operation should be limited to the removal of one lobe (or a part of it) and the isthmus. If this is done, there is no danger of myxoedema, and, while the operation removes the pressure on the trachea, considerable atrophy of the remaining portion occurs, so that no deformity remains.

The dangers of the operation mainly consist in those attaching to the administration of the anæsthetic. A certain amount of risk no doubt is run from *bleeding* or from *the entry of air into the veins*, but these dangers should not be encountered if the operation is properly performed. The bleeding is practically a negligible quantity if the operation is done methodically in the manner described below. Formerly, no doubt, very

furious and even fatal hæmorrhage was common, and it was owing to the fear of this that such a very imperfect operation as simple division of the thyroid isthmus was introduced.

Thyroidectomy.—*The anæsthetic* question is important, and if a general anæsthetic is employed the administrator should be a skilled anæsthetist. Many deaths have occurred from the anæsthetic, and cases are constantly met with that give rise to grave anxiety. Many surgeons, especially abroad, have abandoned the use of general anæsthesia, and perform the operation under local anæsthesia by the infiltration method (see Vol. I. p. 484). These operations performed under local anæsthesia are not accompanied by any great amount of pain; the patient often complains of the dragging and choking sensations caused by the manipulations; but very little pain occurs at any stage, except at the moment of 'dislocating' the enlarged gland. It is also urged as a great advantage of local anæsthesia that the safety of the recurrent laryngeal nerve can be ascertained from time to time by making the patient talk.

When a general anæsthetic is employed, the patient need never be deeply under its influence. If possible, he should be placed in the semi-recumbent position, with a sand-bag beneath the neck so as to throw the head well back and render the tumour prominent. If, however, this position should cause embarrassment to respiration, the anæsthetic must be administered in the position of greatest ease, and in this the patient must remain—at any rate, during the earlier stages of the operation. The anæsthetic should be administered with extreme care and very slowly, and should be either chloroform or ether given by the open method. Ether administered by a Clover's inhaler causes marked venous engorgement and unduly free bleeding. In large goîtres the intra-tracheal insufflation method gives very satisfactory results.

The operation must be performed with the most scrupulous antiseptic precautions, as, if suppuration takes place in the wound left by the removal of the goître, the most serious consequences are likely to ensue; the pus burrows into the mediastinum, and septic thrombosis followed by fatal pyæmia is very liable to occur. If sufficient care be taken to keep the wound aseptic, all danger should be at an end when the operation is complete.

The head should be wrapped in an aseptic towel to keep the hair out of the way, and the skin of the neck should be thoroughly disinfected. Various *incisions* have been recommended, but the best and the only one which we recommend is the transverse incision introduced by Kocher. This incision (see Fig. 25) has a slight convexity downwards, and commences over the sterno-mastoid muscle on one side and terminates at a corresponding point on the opposite side. The incision should be placed as low down in the neck as possible, and its exact length will depend on the size of the tumour. It should be sufficiently long in all cases to ensure full exposure of the gland. At each end, the incision is carried

upwards to an extent varying with the size of the growth, so as to allow of sufficient retraction of the soft parts for proper exposure of the upper part of the swelling; in cases of small tumours the incision may be almost transverse. This incision not only gives a perfect view of the whole region, but it falls into the line of the natural folds of the neck when sutured, and, if carefully stitched with a fine suture, leaves a scar which is hardly noticeable. Even when the enlargement of one lateral

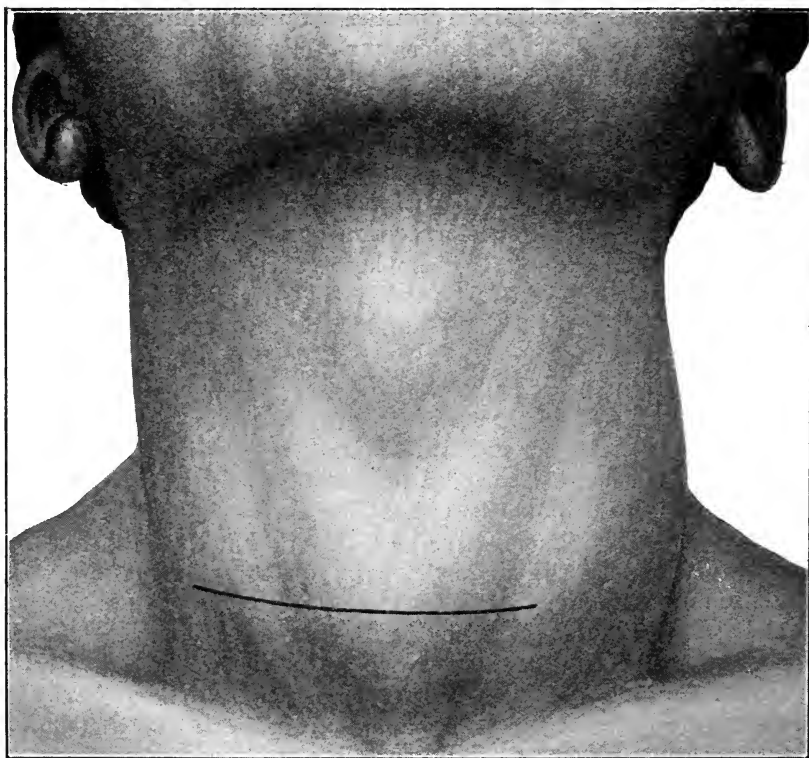


FIG. 25.—INCISION FOR RIGHT-SIDED THYROIDECTOMY. The incision is placed as low as possible over the tumour, but its outer end may be curved upwards to any desired extent in order to reach the superior thyroid vessels.

lobe runs unduly high up towards the hyoid bone, the most perfect access can be gained by curving the end of the incision upwards on that side.

The superficial structures with the platysma are dissected up for some distance, the upper flap being raised as far as the upper border of the tumour, and, meanwhile, care must be taken not to puncture the anterior jugular vein lest air be drawn into it; if it must be divided, it should be seized with two pairs of forceps beforehand and divided between them. The upper flap should be well retracted by an assistant, or if there is a scarcity of assistants, a stitch may be passed through it

and fastened beneath the chin. The superficial structures below the incision are also freed in a similar manner as far down as the top of the sternum. During this part of the operation, care must be taken not to exert any pressure upon the tumour or the larynx so as to avoid interference with the breathing.

The next point is to divide the deep cervical fascia in a vertical direction in the middle line, until the true capsule of the growth is exposed (see Fig. 26). If this is done in the middle line, little bleeding will occur. Care must be taken only to carry the incision down to the capsule of the gland and not through the latter, otherwise the bleeding may be embarrassing. The presence of the thin-walled veins will indicate that

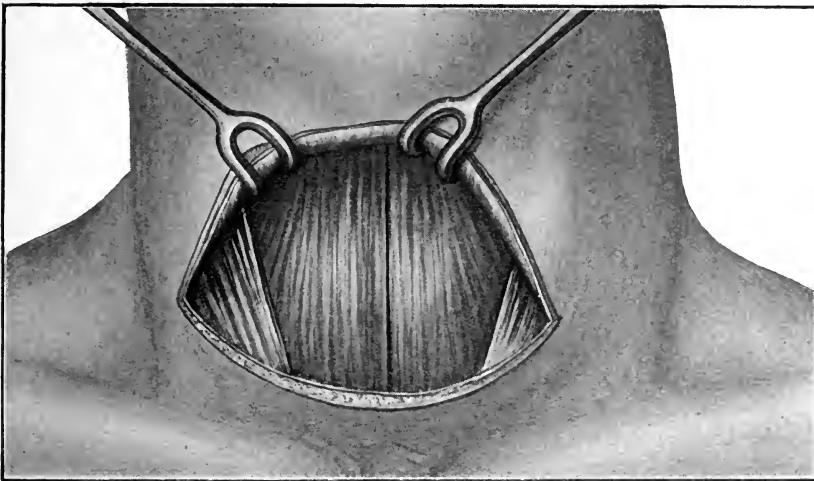


FIG. 26.—THE VERTICAL INCISION IN THE DEEP FASCIA IN THYROIDECTOMY. When the tumour is very large it may be advisable to substitute a free transverse incision through muscles and fascia for the one shown above.

the capsule has been exposed. The finger is now slipped in beneath the infra-hyoid muscles and can, with very little aid from the knife, readily peel the fascia and muscles off the lobe of the thyroid and expose it freely. Any veins divided should be immediately clamped. The infra-hyoid muscles should be raised from the isthmus on both sides of the middle line; on the side on which the lobe is to be left they need not be further detached; on the side from which the lobe is to be removed the muscles should be peeled well outwards; they may be very much thinned and flattened when the tumour is large and care must be taken not to tear them. Should the swelling be very large, it may be necessary to divide them a little below their origin and turn the ends out of the way, suturing them together subsequently at the end of the operation. At this stage there is practically no bleeding; only a few small veins require clamping. The clearing of the lobe to be removed should be continued with the

finger until it can be swept well around the upper pole where the superior thyroid vessels can often be felt pulsating, or can be seen as a whitish band by hooking the forefinger around the upper part of the lobe, pulling it forcibly forward and at the same time retracting the sterno-mastoid. The vessels are seized, and divided between two pairs of forceps.

Another method, which is especially suited for very large tumours, is to divide the deep fascia in the line of the skin incision, and then dissect up a flap of all the tissues superficial to the infra-hyoid muscles, sufficiently high to give free access to the upper pole of the tumour. A similar separation may be made below the incision to enable the lower pole of the tumour to be exposed. The muscles on the side to be removed are then divided as high up in the neck as possible, separated from those of the opposite side, turned downwards and held out of the way with a retractor; the upper ends of the muscles are also retracted. Great care must be taken not to cut into the veins in the capsule of the tumour in dividing the muscles. The upper pole of the lobe to be removed is then cleared as before until the superior thyroid vessels are exposed.

The division of the superior thyroid vessels and the accompanying 'dislocation' of the enlarged lobe marks the most critical period of the operation. Up to this point there should have been no violent disturbance of the relation of parts, as the separation of the structures superficial to the gland can be easily carried out by a single finger swept around, and this does not add to the patient's difficulty in respiration. The next stage, however, does so, and the anæsthetist should be warned at this point so that he may either administer less anæsthetic or stop it entirely if he thinks fit, resuming it after the danger is over.

The dislocation of the enlarged lobe now commences, and should be carried out as rapidly as possible. With the head bent somewhat forward in order to relax the muscles, the finger is passed behind the lateral lobe and is swept all over it, freeing first its upper part which is pulled forwards and inwards by the forceps attached to the lower portion of the band containing the superior thyroid vessels. As the finger frees the posterior parts of the lobe, the latter is pulled more and more inwards until, in a very short time, the enlarged gland slips out of the wound and the further procedures are carried out in the open. As soon as the gland has been dislocated, all lateral pressure is taken off the trachea and the remainder of the operation can be carried out without any risk from anæsthetic accidents (see Fig. 27).

When the gland has been extruded through the wound, the next step is to proceed with the separation of the fascia from its posterior surface. This is steadily stripped down until the lower end of the tumour is reached, near which the inferior thyroid arteries are met with. These

do not enter the lobe in one or two main trunks, as is the case with the superior thyroid, but break up into a number of branches scattered over the lower part of the posterior surface, where they can be easily isolated, clamped close to the gland, and divided. If the isolation of the lobe has been carried out by peeling off the structures from the posterior surface quite close to the capsule of the gland from above downwards, it should be easy to make certain that neither the œsophagus nor the recurrent laryngeal nerve is damaged. With the upper part of the lobe the recurrent laryngeal has no connection, and if everything is cleared steadily backwards and downwards from it towards the œsophagus, the nerve must go with the structures peeled off. As the detachment

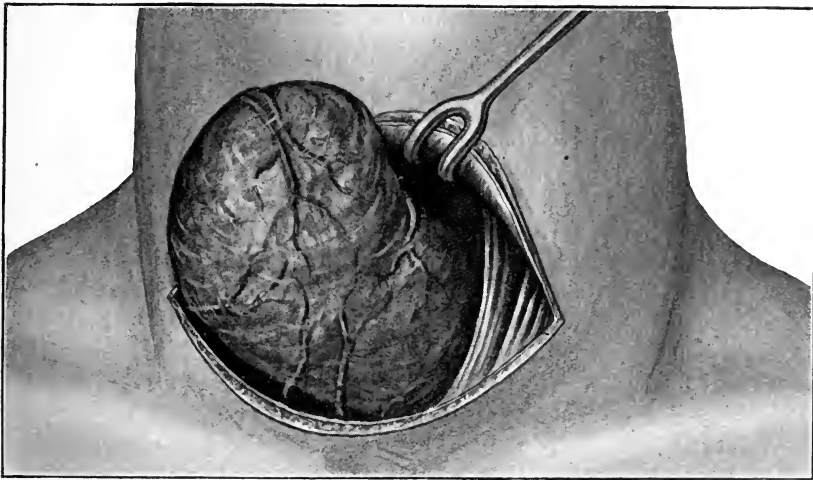


FIG. 27.—DISLOCATION OF THE LATERAL LOBE IN RIGHT-SIDED THYROIDECTOMY.

proceeds, the tumour is pulled steadily inwards to the middle line and is separated from the trachea. It is a good plan to cut into the gland here, and to leave a considerable portion of the gland tissue at the lower and posterior part of the lobe in all cases. The remainder of the lateral lobe is readily raised from the trachea until the isthmus is reached, and then, according to the necessities of the case, the surgeon may either remove the lobe from the isthmus or may carry his separation a little further, raising the isthmus from the trachea, and finally removing the lobe and the isthmus together, leaving the opposite lobe behind. Here the operator must be cautious, as, if the pressure has been great and has lasted for some time, softening of the rings may have occurred, and damage is easily done. In descriptions of this operation it is usual to find instructions given for passing a series of ligatures between the isthmus and the lobe in order to prevent the bleeding when the two are separated. We have, however, never found

this to be necessary, as there is a distinct line of demarcation by fibrous septa between the isthmus and the lobes. The vessels in the isthmus itself are comparatively small, and two or three forceps will suffice to pick up bleeding points. We have contented ourselves, as a rule, with either tearing through the isthmus or the tissues on one side of it.

If the operation is done strictly in this manner it is a safe procedure, and, provided that the capsule is not opened until the gland has been cleared and the thin-walled veins ramifying on the surface of the gland are not injured, the profuse bleeding, formerly so common in these operations, is avoided. An additional point of importance is that time is saved.

We may recapitulate the keys to the operation in the following order : The separation of the fascia, leaving the front of the capsule of the thyroid clean, clamping and division of the superior thyroid vessels, clamping and division of the inferior thyroid vessels and of the veins close to the lower border of the lobe, separation of the lobe leaving a portion at the lower and back part, and, finally, tearing through the isthmus.

As soon as the tumour has been removed, sponges are packed into the large cavity left, the various vessels clamped are tied with catgut, and the wound is inspected for bleeding points, all of which are seized and tied. It is well at this stage to ask the anæsthetist to make the patient strain ; the act of straining opens up collapsed veins which, if not ligatured, might give rise to serious bleeding after the wound has been closed. The muscles must be replaced, or if they have been divided must be carefully sutured, so that no hollow in the neck is left.

We are always in the habit of introducing a drainage tube for one or two days. Although at the time of the operation the bleeding may be absolutely arrested, there is always considerable oozing afterwards into the large cavity in the neck which it is impossible to obliterate by pressure, and the blood-clot may interfere with union, or even cause pressure upon the trachea. The superficial structures detached below the wound are held up, and a small transverse button-hole is made through them just above the sternal notch, of sufficient size to introduce a drainage tube of moderate size (No. 14). A tube is passed in through this opening, and its end should lie beneath the muscles in the lower part of the cavity from which the lobe of the thyroid has been removed. The tube may, if preferred, be brought out through the centre of the incision. It is left in for twenty-four or forty-eight hours. The platysma and deep fascia are next united by fine interrupted stitches, and the skin is sutured accurately with a very fine continuous suture or a horse-hair subcuticular one. A suture is passed through the edges of the small drainage tube incision and its ends left long and knotted, so that it can be tied when the tube is removed. The skin sutures are removed on the fourth or fifth day.

Difficulties during the operation.—These should be few if the precautions indicated above are taken. It may however happen that, when the trachea is seriously compressed, the asphyxial symptoms become alarming during the operation; if this is the case the anæsthetic should be stopped and the operation—at any rate, up to the dislocation of the gland—should be performed without any more anæsthetic, the patient being allowed to regain a proper colour and to breathe naturally before the operation is proceeded with. In some rare cases, however, the asphyxia becomes so serious that it may be necessary to perform tracheotomy; this however should be looked upon as one of the most serious complications that can happen in these operations, as not only is the tracheotomy itself extremely difficult under those circumstances owing to the distortion and narrowing of the trachea, but it is also impossible to keep the wound in the neck aseptic. The surgeon and the anæsthetist must therefore be constantly on the watch to avoid this untoward accident. In view of the fact that a tracheotomy may be necessary, the surgeon should always be provided with an extra long flexible tracheotomy tube (see Fig. 28), which may be bent to any required curve, and he should also have at hand several large catheters, which may be used to pass down through the tracheotomy opening so as to get beyond the constricted portion. The ordinary tracheotomy tube is hardly ever efficient if there is much lateral compression of the trachea, as it will not reach sufficiently far down.



FIG. 28. — KÖNIG'S
LONG FLEXIBLE TRA-
CHEOTOMY TUBE.

If a tracheotomy has been done, every precaution must be taken during the further progress of the operation to prevent blood passing down the trachea, and an assistant should be told off especially to look after this. We have, fortunately, not had any experience of this accident.

Should there by any chance be serious bleeding from the raw surface left when the lobe and the isthmus are detached, and should it be impossible to seize the vessel satisfactorily in forceps, the bleeding point should be underrun either with a fully curved intestinal needle or a nævus needle, threaded with catgut.

After-treatment.—The ordinary gauze dressings are applied and fixed with bandages carried beneath the shoulders as well as around the neck and head to prevent shifting of the dressing, and the patient is put back to bed lying flat upon the back, with a small pillow beneath the head so as to tilt it slightly forward and relieve all tension upon the line of incision. The head should also be steadied by a sand-bag on either side. As soon as the anæsthesia has passed off, the patient's head and

shoulders are raised on pillows, the head being kept slightly flexed. The dressing should be changed at the end of twenty-four or forty-eight hours, when the drainage tube may be left out, as a rule, and the temporary stitch tied so as to close the opening in the skin. Recovery is usually extremely rapid and the relief from the removal of the enlarged gland is marked and immediate, so that the patient begins to breathe normally, even before the operation is completed.

Cases sometimes occur which are marked by distinct and peculiar symptoms of so-called '*thyroidism*' after this operation. These symptoms consist mainly of high temperature, and a rapid pulse (about 120) which is sometimes irregular. There is also a feeling of suffocation and restlessness, and there may be slight delirium; in some cases death has occurred without any further symptoms. It is presumed that these symptoms are produced by the absorption of the thyroid secretion poured out into the cellular tissue from the raw surface made by detachment of the enlarged portion of the gland. We have operated on a large number of these cases, and have not met with this condition, and we are inclined to regard it as in the main a septic condition rather than one due to absorption of thyroid secretion. Should it occur, free drainage must be employed, and it has been suggested that the wound should be washed out.

When *septic infection of the wound* occurs, the latter must be opened up and drained freely. It should be lightly packed at first with cyanide gauze wrung out of 1 in 2000 perchloride, and subsequently drained by tubes. A culture should be made from the discharge and an appropriate vaccine or serum given. Sepsis in the wound is a very serious complication and it is very apt to spread in the connective tissue-planes of the neck and downwards to the mediastinum. The condition may be followed by the formation of very persistent sinuses.

THYROID ADENOMATA AND CYSTS.

In our experience these form the majority of thyroid enlargements with which the surgeon has to deal. The gland as a whole is unaffected, but small nodules of thyroid tissue take on independent growth forming tumours surrounded by a well-defined capsule. The adenomata may be single or multiple, and may grow to a large size, giving rise to much enlargement of the portion of the gland involved, which may cause serious inconvenience to the patient. An *adenoma* is generally globular or oval in shape and has a smooth surface. When it is large, there may be very little of the original thyroid lobe left, and when one lobe alone is affected or the two lobes are affected unequally, the trachea is displaced to the side opposite to the one on which the chief enlargement is, and severe dyspnoea is often the result. In other cases the adenoma grows forward as it increases, and gives rise to only slight pressure effects; in such

cases large tumours may be present and only cause disfigurement. When the adenoma is deeply placed in the lower part of the gland, behind the sternum, and the pressure is in the antero-posterior direction, there is often interference with deglutition and respiration. Multiple adenomata may be associated with general enlargement of the whole gland, in addition to that due to the presence of the tumours; such cases are often called adeno-parenchymatous goîtres.

Other *simple tumours* are stated to occur in the thyroid gland, but are very rare.

Cysts of the thyroid are also common, and are definitely encapsuled and usually multiple. The cystic condition is usually a cystic transformation of previously existing adenomata, so that we may speak of thyroid adenomata as being in some cases solid, in others cystic. When the cyst has reached a large size very little remains of the original adenomatous tissue may be left. Both the adenomata and cysts are liable to degenerative changes. Deposition of lime salts is very common, and may cause the tumour to have a hard, irregular surface suggesting malignant disease. Hæmorrhage into the substance of the tumour also occurs, and leads to a rapid and often sudden increase in size, with severe pressure symptoms, especially dyspnœa.

Echinococcus cysts are also met with in the thyroid and closely resemble ordinary adenomatous cysts. Instances have been recorded in which the cyst has ruptured into the trachea and caused a fatal result. We need not describe these further as their characters and treatment are practically those of the ordinary cystic adenoma.

TREATMENT.—This is purely surgical, and the operations for the removal of cysts and adenomata are identical. The thyroid gland is exposed in the manner already described for thyroidectomy (see p. 108), and the tumour, as a rule, is found towards the surface of the gland with little true thyroid tissue intervening between it and the capsule. The capsule of the gland and any thyroid tissue beneath it are divided over the tumour at a point where the vessels are least abundant, and are then separated until the true capsule of the latter is reached, when the adenoma or cyst is shelled out of its bed with a blunt dissector, aided by the finger. The tumour itself is usually of a greyish or bluish white tint which contrasts with the red colour of the normal thyroid tissue. The swelling should be taken out whole, with its capsule intact; as soon as a little separation of the anterior surface has been effected by the instrument, the finger is passed in and swept round the tumour so as to detach the rest. There is as a rule little bleeding; a few vessels at the bottom of the cavity from which the tumour has been removed being all that require ligature.

These swellings are often multiple, and therefore after one has been removed the rest of the gland should be carefully examined for others; any present are enucleated by boring down to their capsule through the

thyroid tissue from the cavity left after removal of the first tumour. The finger is then swept round them and they are turned out ; it is seldom necessary to make a fresh incision through the capsule, as the bleeding when boring through the gland is very slight. In this way a large number of adenomata may be shelled out without the necessity for removing any of the true gland-substance. It may, however, be advisable to remove the greater part of the affected lobe as described for thyroidectomy (see p. 108) in some cases. It is quite possible, and indeed not unlikely, that adenomata may be left behind if enucleation only is performed, and these may increase and require removal subsequently. While it is best to remove the tumours entire, the capsule is sometimes so thin that it tears. In the case of a cyst of large size, no harm will be done if it is ruptured. The diminution in size may indeed add to the ease of the separation. When, however, soft adenomata have to be removed piecemeal, portions may be left behind and grow again. Hence the capsule of the tumour must be very gently handled so as to avoid this accident.

Difficulty may be met with in cases of long-standing cysts in which the walls are calcareous and firmly adherent to the gland in which they lie, and also in cases in which the cyst has been punctured or injected, and inflammation has been set up around it. Under these circumstances, and also when nearly the whole gland has been replaced by the tumour, it is best to remove the greater part of the lobe in which the swelling lies, and the operation will then be a partial thyroidectomy (see p. 108). Special care must be taken to preserve the recurrent laryngeal from danger, as cysts which have been repeatedly tapped or injected may contract very firm and extensive adhesions.

The *after-treatment* is the same as for thyroidectomy. A drainage tube should be introduced either from a separate opening or, if the tumour is small, directly through the wound over the seat of enucleation.

INTRA-THORACIC GOÎTRE.

When the thyroid is either generally enlarged or when adenomata are present, it is not uncommon for a part of the lower segment of the swelling to extend behind the sternum and clavicle into the upper part of the chest. Particular care should therefore be paid to this point in the case of any enlargement of the thyroid, because it is an important indication for operation. Moreover, it is always advisable in operating on goîtres to pass the finger behind the sternum in order to make certain that there is no tumour in the chest, and this especially applies when there is some difficulty in enucleating an adenoma. In another class of cases, there is often only slight enlargement of the thyroid gland in the neck, and yet on careful examination the presence of a large tumour

may be detected in the superior mediastinum. Dullness on percussion may be present, and a fullness in the region of the supra-sternal notch, and, when the patient coughs or swallows, the tumour may become much more evident at the root of the neck as it rises up. Sometimes X-ray examination will reveal the presence of a definite shadow in the upper part of the chest. Dyspnœa, which may be permanent or intermittent and brought on by the slightest exertion, is the most frequent symptom, and we would strongly emphasise the importance of bearing this condition in mind in examining a case in which dyspnœa is a prominent symptom.

TREATMENT.—As soon as the condition is diagnosed, operation should be performed. No other treatment can possibly do any good and, as the pressure-effects may at any time suddenly increase, removal should be undertaken without delay. The tumour is generally an adenoma and can be enucleated through a transverse incision at the lower part of the neck. The steps of the operation are the same as those on p. 115. The close proximity of the great vessels, especially the veins, must be borne in mind and care taken not to tear them. When the tumour is cystic or partly cystic, its size may be reduced by puncturing the cyst. It will always be advisable to insert a drainage tube into the cavity left after the removal of the tumour.

Treatment of Goître by Tracheotomy.—Except for the purpose of giving relief to the dyspnœa in malignant disease and in that rare affection called primary chronic inflammation of the thyroid, tracheotomy has no place in the treatment of goître. At the present day, no patient with a non-malignant goître ought to be allowed to pass into such a condition as to suggest the necessity for tracheotomy. Even when the dyspnœa is severe, it should be relieved by the removal of one lobe of the gland or of the tumour causing it, and not by tracheotomy. It is true that under these circumstances, such an operation is one of great risk; but so also is tracheotomy, as the trachea is flattened—usually laterally—until it is no thicker than an ordinary rib, and it may be extremely difficult to find and open it. The hæmorrhage from the engorged veins may be most profuse, and the time spent in trying to find the trachea, under these circumstances, could be better utilised in relieving the pressure on the trachea by raising and removing the tumour, and then carrying out artificial respiration if necessary.

MALIGNANT GOÎTRE.

The usual form of malignant disease of the thyroid is carcinoma, which follows the same course as carcinoma elsewhere, destroying the organ in which it is growing, infecting the neighbouring glands and spreading to other parts of the body. The disease is generally rapidly fatal, six months being about the average duration of life from the time

that the trouble is discovered. This rapidity is partly due to the pressure on the trachea producing gradually increasing dyspnoea ; partly also to the great general weakness which follows the destruction of the gland and which is doubtless, to some extent, due to the loss of thyroid secretion.

The *symptoms* of malignant goitre are pains of a lancinating character, accompanied by difficulty in swallowing and severe dyspnoea. The tumour is a densely hard, irregular growth which compresses the trachea and the oesophagus, and infiltrates the tissues around. The points serving to distinguish these tumours from simple enlargements are that, in the latter, the vessels are pushed outwards and may be found even as far out as the posterior triangle, while malignant tumours surround these structures and do not materially displace them, and that one or both vocal cords may be paralysed from cancerous infiltration of the recurrent laryngeal nerves.

Sarcoma of the thyroid may also occur and is usually of the spindle- or round-celled variety. There is not the same infiltration of the whole gland as in carcinoma, but a very rapidly growing tumour generally forms in one lobe. The diagnosis will probably not be made until after removal. The extreme rapidity of the growth will however arouse suspicion as to its true nature.

TREATMENT.—Attempts have been made to remove carcinoma of the thyroid by operation, but these practically always end in failure. The gland soon becomes widely infiltrated with the disease, and the whole mass is firmly adherent to the surrounding structures, particularly the trachea and the oesophagus, and, in attempting to detach it either of these structures may be opened, or portions of the disease may be left behind and the trouble is rapidly reproduced. Hence no attempt at operative interference should be made unless the patient is seen at a very early stage, and the growth is limited to one lobe of the gland, and has not penetrated through the capsule.

Palliative treatment will, however, be called for, as the difficulty in breathing must be relieved ; and tracheotomy should therefore be done and a long flexible tracheotomy tube (see Fig. 28) introduced before the operation becomes too difficult. Especial care should be taken to determine the position of the trachea before making the skin incision, as this should lie over the trachea, which may be considerably displaced.

PRIMARY CHRONIC INFLAMMATION OF THE THYROID.

This is a rare affection and is mentioned here because it closely simulates malignant disease. Its cause is unknown. Microscopically, the appearances are those of chronic inflammation, and the structure shows dense fibrous tissue with spindle-cells and remains of the gland substance. It affects patients of middle age, and, beginning in one or both lobes,

leads to the formation of a dense, hard tumour, which is painless and steadily increases in size. It infiltrates all the surrounding structures if left alone, and may cause severe dyspnoea.

TREATMENT.—In the early stages removal of the affected lobe should be undertaken. In the later stages tracheotomy may be necessary to relieve the dyspnoea. It is possible that thyroid extract may be beneficial. We have had two cases, probably of this nature, which certainly showed a great improvement after being treated with the extract.

EXOPHTHALMIC GOÎTRE.

During the last few years, the surgical treatment of this affection has been undertaken with increasing frequency, and therefore it is necessary to discuss it in some detail. The affection is most common in women between the ages of twenty and forty; it often comes on after overwork, worry or severe mental shock, and may be associated with uterine or ovarian irregularity.

Clinically, the disease may be divided into (a) cases in which the gland was previously healthy and the well-known symptoms develop primarily, and (b) cases in which symptoms of exophthalmic goitre develop secondarily in a gland that has been for some time the seat of parenchymatous changes or of adenomata or cysts. A large number of patients with an ordinary parenchymatous or adenomatous goitre suffer from increased frequency of pulse, palpitation, and even dilatation of the heart, but these are not true cases of exophthalmic goitre and do not follow the course of that disease. Moreover, the gland does not show the changes characteristic of exophthalmic goitre, and therefore great care should be taken not to confuse the two conditions.

Exophthalmic goitre has a very definite train of *symptoms* consisting essentially of palpitations, tachycardia, irregular heart-rhythm, anæmia, fibrillary tremors of the muscles (most marked in the upper extremity and the tongue), protrusion of the eye-balls accompanied by the symptom known as Von Graefe's sign (namely, a lagging behind of the upper eyelid when the patient looks down, so that the sclerotic is visible between the lid and the cornea), and more or less marked enlargement of the thyroid gland accompanied by pulsation, thrills, and bruits about the root of the neck. The enlarged gland is smoother and more doughy than an ordinary goitre.

The progress of the disease varies in different patients and is subject to exacerbations and remissions. In a small number of cases the disease becomes arrested either spontaneously or under medical treatment. In the majority it steadily progresses, toxæmia and degenerative changes being the most pronounced features, as indicated by mental excitability, extreme nervousness, low blood-pressure, diarrhoea, albuminuria, and dilatation of the heart. The last sign is one of the

most important. Dilatation of the heart may become extreme, and should be always carefully looked for and the degree estimated if surgical treatment is being considered. Degeneration of the cardiac muscle also constantly occurs to a greater or less extent and is combined with the dilatation; this is the cause of the irregular pulse and of the sudden death which is not infrequent in this affection. Changes in the blood are frequently present, and consist of diminution in the total number of white cells, increase in the lymphocytes and decrease of the polynuclears; such alterations are, however, not pathognomonic. The stage of the disease should be estimated from the severity of the signs and symptoms and not from the length of time that they have been present.

Pathology.—The disease is now generally considered to be a primary hyperplastic affection of the thyroid gland, which presents characteristic changes—the chief of which are absence of the colloid and of the enlarged vesicles, so that the gland appears to the naked eye as a firm, solid mass. A cut section has often a granular surface owing to the occurrence of these changes in patches. When the affection is secondary to some other enlargement of the thyroid it is often possible to recognise the areas where the hyperplastic changes are taking place. Microscopically, there is a great increase in the epithelial elements which tend to become columnar, an absence of colloid, and increased vascularity. The thymus gland is also constantly enlarged, but the exact relationship of this change to the disease is not known. Changes in the central nervous system and in the cervical sympathetic have been described: they are probably secondary to those in the thyroid gland.

TREATMENT.—(a) **Medical.**—Medical treatment cannot be relied on to cure the disease, but it may however alleviate the symptoms for a time, and should always be employed as a preliminary to surgical measures, except when the affection is secondary to an ordinary goitre. The physician should carefully estimate the degree of toxæmia so that surgical measures may be undertaken before the time arrives when they would be attended with too grave risks, and when the chance of benefit from them would be slight. Complete rest in bed should be ordered, freedom from work, worry, and anxiety should be secured if possible, and any uterine or ovarian disorder should be corrected. The patient should be placed among as cheerful surroundings as possible, and change of air is useful. Many drugs have been employed in the treatment of this affection. If the patient is markedly anæmic, arsenic is especially indicated, whilst bromide of potassium is valuable for sleeplessness or excitement. Digitalis and other cardiac tonics may be necessary when the heart symptoms are marked. Kocher recommends the administration of sodium phosphate. Thyroid extract and the iodine compounds should not be given. Rodagen and the administration of serum from

thyroidectomised goats may be tried, but are of doubtful value. The diet should be plain and simple—no restriction need be placed on it, provided the patient can digest it and puts on flesh. X-rays have been employed with occasional good results ; they should only be applied by a skilled operator, and great care must be taken to avoid burning the skin. Repeated applications are necessary and the treatment must extend over a long period.

(b) **Surgical.**—The risks of operation in this disease are much greater than those in ordinary goître, and therefore operation should only be undertaken by a surgeon who is accustomed to operating on the thyroid gland and has complete confidence in his operative technique. A careful examination of the patient as to the degree of toxæmia and the presence of secondary degenerations should always be undertaken before operation, because if these changes are advanced the risks may be out of proportion to the benefits likely to be obtained. The surgeon may be called in when there are evidences of advanced degenerative changes in the heart and other organs, and under such circumstances no operation should be performed ; he has been called in too late. The most successful cases are the early acute ones before there is any marked evidence of secondary degeneration in other organs, and also those in which the disease is secondary to some other form of goître. There are periods in the course of the disease when it may be unadvisable to operate and yet, by waiting, a favourable opportunity may arise. Patients in whom the disease is steadily progressing should be operated on before cardiac dilatation occurs. Patients with a constantly irregular pulse and low blood-pressure, persistent albuminuria, and a high lymphocytosis are unsuited for operation ; unless and until these conditions disappear, operation is contra-indicated.

The operative measures at our disposal are ligature of one or more of the thyroid arteries, and partial thyroidectomy. Division and removal of the cervical sympathetic, which was advocated and practised a few years ago, has now been generally abandoned.

Ligature of one or both superior thyroid arteries is a comparatively easy operation and is less severe than partial thyroidectomy. Ligature of the inferior thyroid artery is a difficult operation and is not as a rule necessary ; it may be as difficult as a thyroidectomy itself. The superior thyroid artery should be tied as close as possible to the gland, or the ligature may be placed so as to include the upper pole of the gland ; if possible the vein should not be included in the ligature. In early cases ligature of one or both superior arteries will often bring about a cure. In severe cases it is advisable to tie first one and then the other, an interval of a few weeks being allowed to elapse between the two operations ; partial thyroidectomy may be subsequently performed if necessary.

Ligature of the Superior Thyroid Artery.—A transverse or slightly curved incision with its convexity downwards is made opposite to the

interval between the upper border of the thyroid cartilage and the greater cornu of the hyoid bone. The anterior borders of the sterno-mastoid and the omo-hyoid muscles are exposed, the artery being found in the interval between them; the upper pole of the gland is a good guide to the artery. The vessel should be ligatured in two places and divided between the ligatures. The ligature should include the large branch distributed to the posterior part of the lateral lobe.

Ligature of the Inferior Thyroid Artery.—An incision is made along the posterior border of the sterno-mastoid extending upwards from the clavicle. The muscle and the carotid sheath are displaced inwards. The tendon of the omo-hyoid is sought for—this being a good guide to the position of the artery—and the vessel will be found lying on the inner edge of the scalenus anticus. It will be necessary to displace the goitre considerably in order to reach the main branch of the vessel.

Thyroidectomy may be preferable when the gland is markedly enlarged, one lobe—the larger—being removed. The removal of one lobe and partial extirpation of the other should never be done at the same operation. If necessary a second operation may be carried out on the opposite lobe at a later date, and it is hardly necessary to point out that the gland should never be completely removed. The details of the operation are described on p. 107; it may be a much more difficult procedure than in the case of a simple goitre, as it is not always easy to displace the firm solid gland, and troublesome bleeding is not unlikely to occur as the veins are often very large. Hence great pains must be taken to reduce the amount of blood lost to a minimum by careful hæmostasis and to complete the operation as quickly as possible. It greatly facilitates the operation if the main vessels are ligatured at an early stage.

The question of anæsthesia is a most important one. Whenever possible local anæsthesia by means of a 1 per cent. solution of novocain should be employed. The chief reason for using local anæsthesia is the liability to sudden death in these patients. If for any reason a general anæsthetic is desirable, ether by the open method is the most suitable.

After-treatment.—Plenty of normal saline solution should be administered by the rectum, subcutaneously, or intravenously. Restlessness must be combated by sedatives and stimulants given as required. A rapid rise in pulse-rate and temperature, sweating and oppression are quite common after the operation and are often very alarming. Sudden attacks of cardiac failure may occur even when the patient is apparently doing well.

The operation should be followed by a prolonged period of rest, freedom from mental worry and excitement, and a change to the seaside, or, if preferred, to mountain air.

Results.—There is a general consensus of opinion among surgeons that great benefit is derived from these operations, in some cases even from ligature of one superior thyroid artery alone. Not infrequently the patient will state that she is feeling much better even though the objective signs of improvement are not manifest. Palpitations, nervousness, and feelings of oppression may disappear and the patient may be enabled to enjoy life and to work in comfort. In other cases, the tremors and rapidity of pulse also disappear, while the aspect of the patient and the increase in weight show obvious signs of improvement. It is an interesting fact that the exophthalmos is rarely, if ever, completely lost.

CHAPTER X.

PERSISTENT THYRO-GLOSSAL TRACT: INJURIES OF THE LARYNX.

PERSISTENT THYRO-GLOSSAL TRACT.

THIS embryonic structure commences at the foramen cæcum on the dorsum of the tongue and runs downwards in the middle line of that organ, passing behind or through the body of the hyoid bone and in front of the thyroid cartilage to the isthmus of the thyroid gland; the thyroid isthmus is developed from it. As a rule the entire tract is obliterated, but the whole or a portion of it may remain and give rise to a central fistula, the lower opening of which is situated just above the thyroid isthmus. In other cases the tract may be obliterated at both ends and an unobliterated portion in its course may become dilated, leading to the formation of a cyst, either in the neighbourhood of the base of the tongue or just in front of the thyro-hyoid membrane and extending upwards behind the hyoid bone.

TREATMENT.—Of a fistula.—A thyro-glossal fistula may cause so little trouble that it may not be necessary to adopt any treatment for it. In some cases, however, the fistula discharges; and is a source of irritation and discomfort. The only treatment likely to do good is to dissect out the fistula completely. It will not close until its epithelial lining has been entirely removed, and any attempt short of excision, such as destruction by caustics or the cautery, invariably fails.

The complete removal of the fistula is not easy. An incision is carried downwards from the upper border of the hyoid bone, diverging below so as to enclose the orifice of the fistula. The fistulous tract is defined by passing a probe along it, or by injecting a 5 per cent. solution of methylene blue into it, and its wall is then dissected out. In cases in which the sinus runs up near the foramen cæcum, difficulty is met with when the posterior surface of the hyoid bone is reached, because it

is not at all easy to remove the upper part of the tract. In these cases the skin incision should be prolonged up towards the chin and the tongue-muscles separated until the fistulous canal is exposed above the bone; the separation is then continued and the entire tract removed. It may be necessary to divide the hyoid bone, and if so, it is best to cut it across on each side of the middle line and turn the central portion up; this piece of bone is replaced and stitched into position after the operation is completed. A drainage tube should be placed above the hyoid bone for a few days.

Of a cyst.—The treatment of a cyst is likewise very troublesome. It should be removed, as it tends to increase in size and may not only cause deformity, but may interfere with the patient's comfort. Tapping is of no use whatever, while complete extirpation is even more difficult than the removal of the upper part of the fistulous tract described above, on account of the lateral extent of the cyst. Nevertheless, if the cyst is a cause of serious annoyance to the patient an attempt must be made to remove it in a manner similar to that recommended for removal of the duct.

ENLARGEMENT OF THE THYRO-HYOID BURSA.

The diagnosis between this condition and a thyroglossal cyst is sometimes a matter of considerable difficulty. The distinct limitation of a bursal sac, its central situation, and the fact that it bulges below the hyoid bone rather than above it, are points in favour of a bursal swelling.

TREATMENT.—The simplest plan is to dissect out the bursa. A transverse curved incision, with its convexity downwards is made across the lower border of the cyst, and exposes its anterior wall, which is then defined laterally by pushing the tissues aside, and the bursa is shelled out.

INJURIES OF THE LARYNX.

FRACTURES OF THE HYOID BONE.

These extremely rare injuries generally result from direct violence, such as suicide by hanging or attempts at throttling. In death from hanging, the body of the bone is often broken; whereas in attempts at throttling the fracture usually occurs at the junction of the body with one of the cornua. The injury is generally accompanied by great pain, and, if the fracture is compound into the throat, as it frequently is, there may be severe hæmorrhage from the mouth; difficulty in swallowing and speaking may be also very marked.

Severe dyspnœa with constant cough and expectoration are very

likely to occur later on as a result of the inflammatory disturbance about the fracture.

TREATMENT.—The displacement is best reduced by manipulation. The throat is painted with a 10 per cent. solution of cocaine, and the forefinger of one hand is introduced into the pharynx, whilst the other hand, placed outside, manipulates the fragments into position. Should cocaine be insufficient, a general anæsthetic must be given. Although reduction of the deformity is easy, there is great difficulty in keeping the fragments in position. An attempt may be made, by the application of a properly moulded pasteboard or poroplastic collar, to prevent all lateral movements as well as flexion and extension of the neck, and swallowing should be restricted for the first three or four days, food being given entirely *per rectum*. In addition to this the patient should be kept as much as possible in the upright position.

The results thus obtained are very disappointing, and a better method would seem to be to expose the fragments and stitch the ends together through a transverse incision over the seat of the fracture, care being taken not to deepen the incision too far outwards or too low down, as this would endanger the superior laryngeal nerve. This method gives the patient immediate relief from pain and avoids the possibility of subsequent interference with the movements of the larynx as a result of mal-union of the fragments.

In a compound fracture, an external opening—such as would be necessary in the above operation—will be beneficial by providing suitable drainage and preventing any oedematous inflammatory swelling.

FRACTURES OF THE CARTILAGES OF THE LARYNX.

These fractures are rare, and are produced by causes similar to those which give rise to fracture of the hyoid bone.

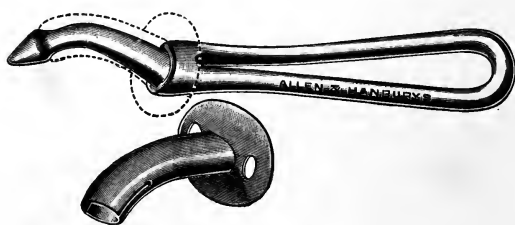


FIG. 29.—BUTLIN'S LARYNGOTOMY CANULA AND INTRODUCER.

The injury is very serious, a large proportion of the cases terminating fatally owing to obstruction consequent on the displacement of the cartilaginous walls of the larynx. If the case is left untreated, this obstruction rapidly increases owing to the inflammatory reaction around the part, whilst in any case it may come on later, even when there has been no difficulty in breathing immediately after the accident.

TREATMENT.—If there is obstruction to the breathing, it is advisable to perform *laryngotomy* at once. A small transverse incision is made

over the crico-thyroid space, its edges are well retracted, the muscles are separated, the crico-thyroid membrane is opened by a transverse incision, and a suitable laryngotomy tube (see Fig. 29) is inserted. At the same time the surgeon should enlarge the incision upwards, expose the alæ of the thyroid cartilage, bring the fractured portions into apposition and secure them by a few catgut sutures. As a rule the laryngotomy tube can be left out after five or six days.

When there is no impediment to respiration, it is unnecessary to have recourse to any active treatment if the patient can be kept under close observation. A suitably moulded poroplastic collar should be worn, and union takes place readily. Should œdema of the glottis supervene, intubation of the larynx or tracheotomy (see p. 134) may be called for. Should the patient be so situated that the surgeon is not readily available in case urgent symptoms arise, it will be safer to perform tracheotomy (see p. 134) in the first instance, or at any rate immediately on the appearance of the slightest swelling.

CHAPTER XI.

FOREIGN BODIES IN THE PHARYNX OR AIR-PASSAGES.

FOREIGN bodies may cause dyspnoea or actual asphyxia, whether they lodge in the pharynx about the upper aperture of the larynx or enter the air-passages proper.

FOREIGN BODIES IN THE PHARYNX.

Foreign bodies lodging in the pharynx and causing difficulty of breathing are usually of large size, such as masses of food or toothplates. These interfere with respiration mechanically and a sudden and fatal asphyxia may result unless prompt and effectual treatment be adopted.

TREATMENT.—In all cases in which the patient becomes suddenly asphyxiated, either during eating or vomiting, the first thing to be done is to force open the jaws ; if no gag is at hand, the handle of a knife, a spoon, or any other convenient article, should be introduced between the teeth, and the jaws levered apart. The finger is then pushed well back into the pharynx and swept round the orifice of the larynx in search of the foreign body which is causing the obstruction. If it is situated outside the air-passages proper, it can generally either be pulled up with the finger or pushed down into the œsophagus. When the obstruction is not easily dislodged, laryngotomy must be performed immediately (see p. 143) in order to save the patient's life. The patient may begin to breathe as soon as the laryngotomy is done, but when this is not the case, artificial respiration should be commenced, and when breathing has been re-established, the surgeon can proceed to extract the foreign body. This should be done with forceps bent at a right angle, the throat being illuminated by a frontal mirror. When the foreign body is a toothplate, the chief obstacles to removal are the sharp hooks which catch in the tissues ; these may be so firmly impacted that it is necessary to break up the plate with cutting-forceps before it

can be extracted. As soon as the foreign body has been removed, the laryngotomy tube may be taken out and the wound allowed to heal. No stitches should be inserted, otherwise emphysema will very probably occur.

FOREIGN BODIES IN THE LARYNX AND TRACHEA.

Foreign bodies may enter the larynx as the result of sudden inspiration during swallowing, such as is caused by laughing or talking whilst eating. In other cases the material may come from the stomach, as for example during vomiting when a patient is drunk or under an anæsthetic. Artificial teeth are the most common foreign bodies in adults ; buttons, sweets, fruit-stones, and small toys in children.

A large foreign body may completely obstruct respiration and give rise to such urgent dyspnœa as to call for immediate tracheotomy, the removal of the foreign body being carried out subsequently. In less complete cases its impaction in the larynx excites sudden pain, violent cough and fits of choking, accompanied by intense terror. A fatal result may ensue not only when the body is large enough to block the larynx completely, but even when it is small ; in the latter case it is the result of the acute spasm to which it gives rise. Should the spasm not be immediately fatal, it subsides after a time, although the body may remain in the air-passages ; it may then produce very few symptoms, of which the chief are slight cough and a sense of discomfort. As long, however, as the foreign body remains in the air-passages there is constant danger of spasm of the glottis should it alter its position.

A smooth, rounded body lodged in the ventricle of the larynx may give rise to no symptoms after the initial convulsive attack has passed off, but a sudden suffocative attack should always excite the suspicion of the presence of a foreign body, especially in children, even when no definite history can be obtained. If the body is sharp, it may cause hæmorrhage, and the blood in the air-passages may then set up severe dyspnœa. In other cases inflammatory swelling of the mucous membrane occurs after a few days and is accompanied by increasing dyspnœa.

In other cases again, a small body—such as a button or a fruit-stone—may pass into the trachea and remain freely movable there, or it may be drawn down and impacted in one of the bronchi—usually the right, the opening of which is larger and in a more direct line with the trachea than is that of the left. When a movable body is present in the trachea, the patient can breathe fairly freely after the first spasm has passed off, as long as he remains quiet, although respiration is usually noisy and rattling. As soon, however, as he exerts himself or coughs, the foreign body is driven up against the glottis and sets up fresh spasm. The condition is not common, however, because if the body is small enough to

pass into the trachea, it generally becomes impacted in a bronchus, which it blocks either partially or completely according to its shape and size. If, however, the body is sharp, it may become entangled in the trachea; in one case in which we operated, a piece of bone was found which had been present there for a long time, and had given rise to stenosis which had been looked upon as syphilitic.

A foreign body impacted in a bronchus generally causes partial or complete collapse of the corresponding lung. It may act as a ball-valve, preventing air entering on inspiration, but allowing a certain amount to escape on expiration until the collapse becomes complete. A foreign body impacted in a bronchus gives rise to inflammation in the vicinity, while the collapsed portion of the lung is likely to become the seat of *pneumonia*. The inflammation around the foreign body may gradually loosen it, and a recurrence of the laryngeal spasm may indicate that it is again loose and has been projected up against the glottis. In other cases an abscess may form and burst into the trachea, so that the patient coughs up large quantities of pus, or it may burst into the pleura, and be followed by empyema, or rupture into the mediastinum, and give rise to fatal cellulitis.

Bronchiectasis is also a not uncommon result of the impaction of a foreign body in a bronchus, and this association should always be borne in mind in cases of that affection in children.

Examination by means of the X-rays or a direct-vision bronchoscope should never be omitted whenever it is possible to employ these methods, both with the view of localising the foreign body and also of removing it.

TREATMENT.—A foreign body, whether it gives rise to immediate serious symptoms or whether it has become impacted and is accompanied by less severe symptoms, should be removed. The methods of doing so vary with the nature of the foreign body, its situation, and the symptoms it produces.

(a) **Of foreign bodies in the larynx.**—When there is urgent dyspnoea, particularly in children, tracheotomy should be performed as soon as the patient is seen. In adults an attempt may be made to extract the foreign body at once, unless there is very marked dyspnoea. For this purpose the pharynx, larynx, and adjacent parts are anaesthetised with a 10 per cent. solution of cocaine applied by means of a brush. The situation and characters of the body are ascertained by a laryngoscope or a direct-vision instrument (see p. 143). Suitable forceps may then be introduced and the body extracted as gently as possible. In children, a general anaesthetic will generally be necessary and in them it will be safer, if dyspnoea is present, to perform a preliminary high tracheotomy (see p. 134) before attempting to remove the foreign body with forceps. When there is no dyspnoea, it is only necessary to cocainise the larynx so as to prevent sudden spasmodic closure of the glottis as the foreign body is being extracted. Tracheotomy instruments should always be

at hand in case the attempt to extract the foreign body fails and severe dyspnoea is set up.

When attempts to extract the foreign body by the natural passages fail, or when they are not advisable owing to its situation or nature, a thyrotomy should be performed without delay, combined if necessary with tracheotomy. When the larynx has been opened, a smooth foreign body can often be pushed up from below into the pharynx; failing this, it may be grasped with forceps, which are then pushed up into the pharynx and the foreign body is seized from the mouth. Unless the body be very small, there is a risk of lacerating the vocal cords if attempts are made to pull it downwards through the glottis. When the foreign body is angular and its removal is therefore likely to lead to laceration of the parts above the cords—as for example an artificial tooth fixed with a hook—it is essential to split the thyroid cartilage from top to bottom.

After the body has been extracted, the edges of the cartilage should be accurately united and the wound closed above the tracheotomy tube. Should the thyroid cartilage have been only partially divided, its accurate closure is easy. Should it be necessary to split it entirely, it is well before doing so to make a superficial transverse incision across the front of the cartilage, so as to provide a guide for the adaptation of its two halves afterwards. The tracheotomy tube should be left in until all danger of cedema of the glottis has passed off.

(b) **Of foreign bodies in the trachea.**—When the foreign body lies in the trachea, it should be removed as soon as possible by means of a Brüning's tube (see p. 143). If this fails, tracheotomy should be performed; when the body is loose, a high tracheotomy will suffice, provided that the opening is free enough to permit the body to escape easily. In adults it is advisable to use local anæsthesia. After the trachea has been exposed, a sharp hook is inserted into it on each side of the middle line before it is opened (see p. 135). As soon as the incision has been made into the trachea, each hook is pulled upwards and outwards; the trachea is thus fixed and the incision into it dilated. At the same time, the surgeon must be on the alert to catch the foreign body should it be projected upwards opposite the incision. It has happened that the foreign body has thus shown itself, but has been sucked back and become impacted in a bronchus because the opening has not been sufficiently free to enable it to escape. If the body is small and the trachea sufficiently freely opened, the former is generally shot out; should this not happen, the patient may be inverted and shaken, or coughing may be induced by tickling the interior of the trachea with a feather. Should these manœuvres not be immediately successful, Golding-Bird's tracheal dilator (see Fig. 30) should be introduced so as to keep the lips of the incision widely apart, in the hope that the body may be coughed up. If, however, the body is metallic, and an X-ray

screen is at hand, there may be no difficulty in extracting it with forceps, after painting the mucous membrane with cocaine. If it cannot be located by these methods, search should be made for it by means of Brüning's tube introduced through the tracheotomy opening; when found, it may be extracted through the tube or removed as the latter is withdrawn. Under no circumstances should the foreign body be allowed to remain in the trachea.

(c) **Of foreign bodies in the bronchus.**—Should the foreign body be in the bronchus, it must be located by means of the bronchoscope or the X-ray screen (if it is opaque to X-rays). The bronchoscope may be introduced either directly through the larynx

or through a tracheotomy opening. A careful search must be made both during the introduction of the tube and whilst it is being withdrawn, as the foreign body may be hidden in the folds of the swollen mucous membrane, or by a collection of mucus or pus. When it has been located, it is seized with suitable forceps (see Fig. 35) and extracted either through the tube or together with it as the latter is withdrawn. The operation may be very simple or may tax the surgeon's patience to the utmost. When once the body has been seized, great care should be taken not to allow it to slip out of the grasp of the forceps lest it should fall back deeper into the bronchus.



FIG. 30. GOLDING-BIRD'S TRACHEAL DILATOR.

If the X-rays are available, and the foreign body is opaque to them, its removal may present no great difficulty. The patient is anaesthetised upon the X-ray table with the tube in position beneath, and a low tracheotomy is then done in the usual manner (see p. 140). The edges of the opening in the trachea are held widely apart by an assistant, the X-rays are then turned on, and the fluorescent screen is placed upon the front of the thorax. A pair of long flexible tracheal forceps is now passed through the tracheotomy wound and guided direct to the foreign body; the blades are opened and the body is seized and withdrawn.

When, however, neither of these methods is available the case may prove of the utmost difficulty. The situation of the body may often be detected by means of a long probe, and the blades of a long, fine pair of forceps may be gently insinuated between it and the wall of the bronchus. Sometimes a wire bent into a hook, or a ring insinuated past it, may succeed in dislodging it, and it may be then expelled through

the tracheotomy opening. In some cases removal may be facilitated by extending the incision in the trachea downwards as low as possible ; it is always well to do this before abandoning the operation. If this method is unsuccessful, the patient should be sent to some institution where the bronchoscope is available.

In some cases of long standing, empyema has resulted, the pus in the pleural cavity communicating with the foreign body in the bronchus ; should this be the case, attempts may be made to reach the foreign body from the outside of the chest after resection of one or more ribs. We have had a very satisfactory case of this kind in which a boot-button was extracted from the left bronchus through the chest wall. The great drawback, however, is the difficulty in getting the sinus in the chest wall to heal subsequently; as the aperture in the skin communicates directly with one of the larger bronchial tubes ; all attempts may fail even after a most extensive resection of ribs. These cases are dealt with more fully in connection with the surgery of the chest (see Chap. XX.).

CHAPTER XII.

THE OPERATIONS UPON THE LARYNX AND TRACHEA.

TRACHEOTOMY.

THE trachea may be opened either above or below the isthmus of the thyroid gland, which lies over the third and fourth rings of the trachea ; the operation is spoken of as ' high ' or ' low,' according to the situation of the opening relative to the isthmus. In practice, however, there is no strict line of demarcation between the two operations, because it is often necessary to divide the thyroid isthmus partially or even completely. The operation in most frequent use is high tracheotomy, because the trachea is more accessible, the operation is less likely to damage important structures and can be more rapidly done, and there is less likelihood of septic cellulitis spreading from the wound into the anterior mediastinum. When, however, the operation is done in order to reach a foreign body lodged in the bronchus, the low operation is to be preferred as it enables the body to be reached more easily.

When it is necessary to perform a preliminary tracheotomy for the insertion of a Hahn's canula, as in various mouth operations, it is usually best to divide the thyroid isthmus partially or entirely ; this should generally be done in the case of a preliminary tracheotomy for excision of the larynx.

HIGH TRACHEOTOMY.

The patient should be placed in a good light with a firm sand-bag beneath the neck so as to project the trachea forward. If a general anæsthetic is employed, it should be administered very slowly so as not to increase the dyspnoea. The surgeon stands on the right of the patient, grasps the thyroid cartilage between the left thumb and middle finger and places the index upon the pomum Adami ; in this way the trachea is steadied and the middle line indicated. When the chin, the thyroid

notch, and the notch of the sternum have been brought into the same straight line, a vertical incision about two inches long is commenced in the middle line over the cricoid cartilage and carried down well below the level of the thyroid isthmus. It is carried through skin and fascia until the interval between the muscles running from the larynx to the sternum is exposed. The handle of the knife, aided by a few touches of its point, will suffice to separate these muscles, which are then retracted to an equal extent on the two sides. In separating the muscles, care should be taken to avoid puncturing the anterior jugular veins in the upper part of the incision. These are often much dilated if there is much dyspnoea, and the transverse jugular branch joining them must generally be divided; the best plan is to seize it in two pairs of forceps before it is divided and to tie it as soon as possible. When the muscles have

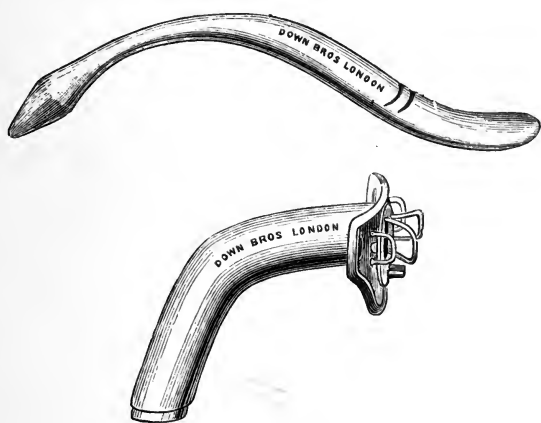


FIG. 31.—PARKER'S TRACHEOTOMY TUBE AND INTRODUCER.

been well retracted, the isthmus of the thyroid and the trachea, covered by the deep layer of cervical fascia, come into view. A transverse incision should now be made through the fascia along the lower border of the cricoid cartilage, curving somewhat downwards at each extremity, and the fascia running from that structure to the isthmus of the thyroid is detached, and the latter is then pushed well out of the way by stripping down the fascia with the handle of the knife. This is a better plan than that of making a median incision through the fascia, and should always be done when time allows, as it saves oozing of blood, which may be very troublesome. A double-hook retractor is now used to pull the isthmus of the thyroid firmly downwards and to steady the trachea, whilst a sharp hook is introduced through the trachea on each side of the middle line, its point passing through the membrane below one of the rings and emerging above the same ring; these hooks are given to an assistant to hold and the trachea is thereby steadied. Another

method of fixing the trachea is to introduce a sharp hook into it just below the cricoid cartilage and hold up the trachea with it, but the two lateral hooks are better as they not only fix the trachea but also retract the edges of the opening. The knife with its cutting edge upwards is now inserted just below the second ring of the trachea in the middle line and cuts as far upwards as the cricoid cartilage; immediately the opening is made, its edges are pulled apart by means of the sharp hooks or separated by a tracheotomy dilator.

When there is no urgency about the operation—for example, when a preliminary tracheotomy is required in connection with certain operations on the mouth and throat—it is well to arrest all bleeding before the trachea is opened. When, however, it is done for urgent dyspnoea, no attention need be paid to the bleeding until the trachea has been opened and a tube introduced. In these cases the venous oozing is often extremely

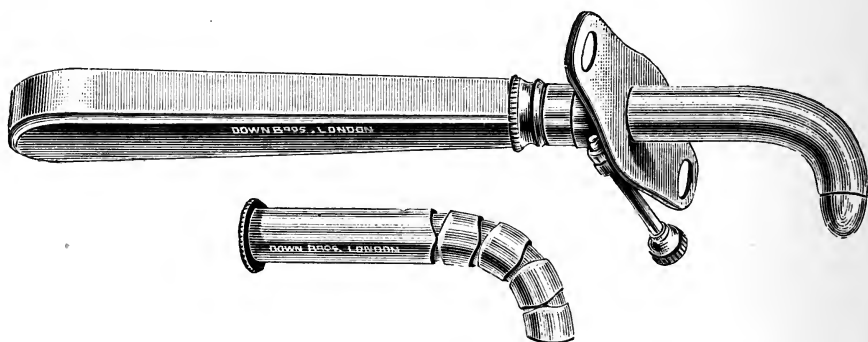


FIG. 32.—DURHAM'S 'LOBSTER-TAIL' TRACHEOTOMY TUBE AND INTRODUCER. The lower figure is the inner tube.

free and practically uncontrollable owing to the great congestion of the parts, but it will stop almost immediately the trachea has been opened and free respiration has become established. If it does not, the methods mentioned on p. 140 should be adopted.

It is important to remember that the trachea may be displaced by various causes, and therefore its exact position must be determined before making the incision in the neck, because the incision must be made over it, otherwise the surgeon may fail to find the trachea at first.

Tracheotomy tubes.—Various forms of tracheotomy tubes are employed, of which the best are Parker's (see Fig. 31) and Durham's lobster-tailed tubes (see Fig. 32). Parker's is more suitable for children, while Durham's is best for adults, especially when the low operation is employed, as here Parker's may not be long enough to reach comfortably into the trachea. The older tubes made in the form of a segment of a circle are bad, because the lower end of the tube is apt to press upon the posterior wall of the trachea and cause ulceration, while at the same time its long

axis does not coincide with that of the trachea. The bivalve tube (see Fig. 33) is bad for permanent use as its sharp edges may cause ulceration of the posterior wall of the trachea, but it is a very valuable emergency tube as it occupies a small compass and can be readily introduced.

The introduction of the tube in the high operation is perfectly easy if the sharp hooks have been employed as described above to steady the trachea, or if a dilator has been introduced and the blades are held open. The handle of the knife introduced into the incision in the trachea and turned transversely is also a convenient means of facilitating the introduction of the tube, or the tube itself may be used to depress one side of the tracheal incision, whilst it is being slipped in.

When the tube has been inserted into the wound, care must be taken to see that air passes freely through it, as in fat patients in whom the trachea is deeply seated, it is easy to force the tube down in front or to one side of the trachea. It is in these cases that a Durham's tube is particularly valuable, as the thickness of the soft parts over the trachea may be allowed for by altering the position of the shield.

Before introduction, the tube should be threaded with tapes, which are passed round the neck and tied together at some little distance from the edge of the wound so that the knot does not interfere with the wound or press upon the vessels. Care must be also taken to see that the tape is not tied sufficiently tightly to embarrass the venous circulation. After the tube has been inserted, silkworm-gut stitches are introduced into the wound above and below the opening so as to close the greater part of the incision.

The best dressing is a piece of boric lint spread with eucalyptus ointment and slit vertically through half its depth so that it can be drawn up on each side of the tube beneath the flange. Layers of gauze wrung out of hot water, and sprinkled with a little terebene, should be laid over the orifice of the tube; this should be changed every half-hour or so. The inner tube should be removed two or three times a day, washed and boiled; should obstruction arise, the tube must be removed immediately and thoroughly cleaned out. Special nurses must be on duty night and day to see that the tube works satisfactorily, and it is important that all material coughed up through the tube should be wiped away immediately with a fresh piece of gauze, so that it does not become sucked back into the trachea. Should the trachea not be completely emptied, it is well



FIG. 33.—BIVALVE TRACHEOTOMY TUBE AND INNER TUBE. There is no introducer to this tube. It is inserted by squeezing together the two wings of the outer tube, which make it very easy to introduce.

to excite coughing occasionally by tickling the interior of the trachea with a feather introduced through the tube. These feathers should be boiled first so as to disinfect them, as otherwise they may introduce septic material, and they should be kept in boric lotion, which is squeezed out before the feather is introduced into the trachea. Unless an obstruction occurs which cannot be remedied by removal of the inner tube, the outer tube should be left in position for the first twenty-four or thirty-six hours, after which it should be removed once or twice a day and cleaned. A fresh tube should always be at hand and introduced immediately on the removal of the old one; the latter should then be thoroughly cleaned in cold water, boiled, and kept in boric lotion until required. A pair of dilators should always be at hand in case the tube is accidentally coughed out and cannot be easily replaced. The insertion

of the dilators will keep the passage open until a fresh tube is inserted.

The subsequent management of the tube varies according to the condition for which the operation has been done. The point of chief importance is the time at which it can be left out altogether. It is obvious that this should be done as soon as it is safe, as it causes a considerable amount of irritation. When the tracheotomy is done for laryngeal stenosis, or for cancer in which no radical operation can be performed, the tube must be retained



FIG. 34.—MORRILL BAKER'S RUBBER TRACHEOTOMY TUBE. There is neither introducer nor inner tube to this.

permanently, but in other cases it is merely a temporary expedient. When the tracheotomy has been done for the removal of a foreign body which has been successfully extracted, the tube should only be kept in for a few hours. It should not be removed at once, otherwise emphysema is likely to occur as the result of the falling together of the edges of the wound and the imperfect escape of air; after a few hours the tissue spaces become sufficiently glazed to render that improbable. In diphtheria, especially in children, the tube should not be kept in longer than is absolutely necessary, otherwise there may be great difficulty in leaving it out, for children rapidly lose the habit of breathing through the larynx; moreover, granulations may form in the upper part of the trachea and cause more or less complete blockage. The factor that will mainly influence the question of the removal of the tube in these cases is the amount and character of the discharge coughed up. As long as membrane and thick mucus are being expelled, the silver instrument must be

retained and the inner tube frequently changed ; as soon, however, as the discharge becomes thin and watery, but is present in sufficient quantity to render it impossible to dispense with the tube entirely, the rubber tube introduced by Morratt Baker (see Fig. 34) should be substituted. This is soft and flexible, and is therefore not nearly so irritating or so likely to produce ulceration of the trachea. The prolonged retention of a silver tube, especially if it does not fit perfectly, is a frequent cause of severe ulceration of the wall of the trachea and necrosis of the cartilages ; in some cases a peri-oesophageal abscess or a direct communication with the oesophagus may form. The india-rubber tube should never be used at first, as, having no inner tube, it can only be cleaned by removing it, and further, owing to its softness, it may become occluded by the lateral pressure of the muscles of the neck ; it should therefore only be employed after the discharge has become thin and the opening fairly rigid. The rubber tube must be properly made, as it has happened that the shield has become detached and the tube has slipped into the trachea. Should this occur, it is usually fairly easy to withdraw it by introducing forceps into the trachea, and grasping the tube. When the india-rubber tube is used, a large hole should be cut in its upper convex surface, so that a certain amount of air passes through the larynx as well as through the tracheotomy opening, and frequent attempts should be made by closing the latter to accustom the child to breathe normally through the larynx. Silver tubes can also be obtained with a hole in the convexity corresponding to the aperture of the larynx. Tubes may be provided with a valve, which opens on inspiration and closes on expiration, thus forcing the air through the larynx. When the child can breathe freely after the external aperture has been plugged, attempts should be made to leave out the tube. In the first instance this must only be done when the surgeon is present, as spasm is very likely to occur in nervous children from the mere thought that they are without the tube ; this may necessitate its immediate re-introduction. In any case the tube should not be left out for more than half an hour or so on the first occasion. Each succeeding period may be gradually lengthened until the tube may often be given up altogether in the course of about a week. Should spasm always occur after the tube is removed, although it is obvious that there is a free passage through the larynx, confidence may be restored by shortening the tube so much that the child wears little more than a shield, behind which cicatrization of the wound can take place. Another method of encouraging the use of laryngeal breathing is to make the child blow out a light, blow a whistle, or play a musical instrument.

The general treatment of the patient will depend upon the condition for which the tracheotomy is performed.

LOW TRACHEOTOMY.

This operation is usually performed when there is no great hurry in opening the trachea, and when therefore the bleeding can be controlled as it occurs; as a rule, however, the hæmorrhage is not so free as in the high operation. The preparations are the same as before, but the incision should commence at the lower border of the cricoid cartilage and be carried down as far as the sternal notch. As the wound is deepened, the innominate vein may bulge up close behind the sternal notch, and may be wounded unless care is taken to avoid it; the anterior jugular vein may require ligature. The deep cervical fascia is divided vertically from the lower border of the isthmus of the thyroid, and it is well to add a transverse incision above; the isthmus of the thyroid can then be pulled well up by a double hook. The trachea is fixed and opened as in the high operation.

Difficulties.—*The trachea may be missed entirely*, especially in a small, fat child; the operator in seeking for it has been known to do serious damage to important structures in the neck. This difficulty is best avoided by taking care that the chin and sternum are in the same straight line, and that the incisions are kept strictly to the middle line throughout. If the trachea is displaced by a tumour or from some other cause, its position should be determined before making the incision, which must lie over it. The finding of the trachea is facilitated by steadying the larynx between the thumb and finger, in the manner recommended above, until the trachea has been opened, and the surgeon should not be flurried in the performance of the operation. No attempt should be made to open the trachea before it has been clearly identified by seeing and feeling the rings; even should respiration cease, the operation should be continued deliberately, and artificial respiration begun as soon as the trachea has been opened.

A cause of great embarrassment to inexperienced operators is the hæmorrhage which may occur in urgent cases; however free this may be, it is almost entirely venous and is due to the great congestion of the veins from the obstruction to respiration. The operator should therefore not stop to arrest it, for, as soon as the opening has been made into the trachea and respiration is freely established, the veins collapse and serious bleeding ceases. If the bleeding should continue after the trachea has been opened, the operator will then have plenty of time to retract the edges of the wound and clamp the bleeding points. A very good plan in urgent cases is to turn the child over upon the face immediately the trachea has been opened, so that the blood finds its way externally and not into the lungs. After the child has been in this position for some time and respiration has become normal, the hæmorrhage is reduced to a minimum, and

can be easily stopped by sponge pressure or by clamping bleeding points.

Not infrequently *the child ceases breathing immediately the trachea is opened*. In most cases this is due to the fact that the patient takes an abnormally deep breath and fills the lungs directly the opening is made, so that there is no immediate need for breathing. If the child is left alone, natural respiration will commence in a few moments, and artificial respiration is hardly ever necessary.

A point of great practical importance is that *the introduction of a tube may not establish free respiration*. This may be either because the tube is not in the trachea or, if it is, because it is blocked by membrane which it has pushed down in front of it. Another possible cause is that the curve of the tube is such that its lower end impinges against the wall of the trachea and is thus occluded. The best means of avoiding blocking of the tube by membrane is to hold the lips of the incision widely open for some little time, either by the sharp hooks mentioned above or by some form of dilator, such as Parker's (see Fig. 31), and to clear the trachea with a feather, which both mechanically removes membrane and promotes its expulsion by coughing.

The introduction of the tube may sometimes be difficult. This is generally due to the opening in the trachea being too small, or to the neck of the patient being short and fat, so that the trachea is situated very deeply. Clumsy attempts at introducing a tube through an insufficient opening may cause serious damage to the structures of the neck, especially if the tube is forced down in front or to one side of the trachea; this may be followed by most serious septic complications. Before opening the trachea, the surgeon should always bear in mind the size of the tube he is about to employ, and should make the incision free enough to enable it to be introduced without difficulty. The tubes are made in sizes according to different ages. The use of the sharp hooks above recommended (see p. 135) greatly facilitates the insertion of the tube, and with them it is almost impossible to go wrong. Should they not be at hand, the manoeuvre of depressing one edge of the incision into the trachea with the tube as it is introduced will suffice. In inserting the tube it should first be held with its long axis at right angles to the long axis of the neck until the point is well within the trachea; it is then rotated through a quarter of a circle until its long axis coincides with the long axis of the body and its introduction completed.

Complications.—There are few complications following this operation, most of the difficulties arising during the progress of the operation itself.

Hæmorrhage does not occur as a rule if care has been taken to ligature all bleeding vessels before the patient is put back to bed, but it may sometimes arise in the later stages from ulceration of the trachea due to a badly fitting tube, or from free oozing from the granulations about the

orifice of the wound. The best method of meeting this is either to dispense with the tube entirely or to substitute the india-rubber one (see p. 138).

Cellulitis of the neck may occur from infection of the wound. This serious condition must be treated by free incisions followed by large boric fomentations frequently repeated. The great risk is that the affection may spread into the anterior mediastinum and end fatally.

Emphysema is rare when a tube is employed, but is apt to occur if the tube is left out immediately after the operation.

Stenosis and adhesions about the glottis sometimes occur and prove most troublesome complications; their presence may involve wearing the tube permanently or at least until the child grows up. They are most likely to occur when the tube has been kept in too long or when the cricoid cartilage has been divided. The treatment consists in passing dilators from the tracheotomy wound through the glottis at regular intervals, or in intubating the larynx. A plastic operation may sometimes be required.

Tracheotomy may be called for to relieve urgent dyspnoea in diphtheria, acute laryngitis, oedema, or stenosis of the glottis. We may add here some remarks with regard to certain points in the operation when it is done for diphtheria.

Tracheotomy for diphtheria.—Some surgeons hold that an anæsthetic had better not be employed in these cases, but we are of opinion that it is of great advantage so long as there is entry of air through the larynx. It is mainly needed for the skin incision and it prevents struggling and therefore further embarrassment of the respiration and consequently less troublesome hæmorrhage.

Chloroform is most suitable for this purpose. Should it be deemed advisable to operate without an anæsthetic, the child should be rolled up in a large towel or sheet so as to confine the arms to the sides, the legs should be fastened to the foot of the table, and an assistant, whose duty it is to retract the wound, should sit at the head of the table and fix the patient's head immovably between his elbows and forearms as he holds the retractors. As soon as the trachea is opened, the patient generally gives a violent cough, and quantities of mucus and membrane may be expelled. The operator and his assistants must remember the risk of infection under these circumstances, and must not therefore be bending over the patient when the trachea is opened; they should always wear thick masks, and some surgeons interpose a glass plate between their faces and the wound. A piece of moist gauze should be thrown over the wound as soon as the trachea has been opened.

It is important not to introduce the tube immediately, but to hold the edges of the trachea aside with sharp hooks or a tracheal dilator, so as to allow free respiration and expulsion of as much diphtheritic membrane and mucus as possible. Indeed, if the child is quiet, it may be advisable

to employ a tracheal dilator, such as Golding-Bird's (see Fig. 31), in preference to a tracheotomy tube, for as long as twenty-four hours.

When the membrane has extended below the tube, it is a good plan to spray a solution of bicarbonate of soda (10 to 15 grains to the ounce), or a saturated solution of bichloride of soda, through it every hour in order to soften the tenacious mucus and allow the trachea to be more easily cleared. Since the introduction of antitoxin, however, not only is tracheotomy much less frequently called for in diphtheria, but there is not the same trouble in getting rid of the membrane.

LARYNGOTOMY.

When the air passages must be opened with the least possible delay for impending asphyxia not due to diphtheria, the most rapid plan is to perform a laryngotomy. The steps of this operation are described in Vol. IV. If circumstances demand it, the operation can be done in a few seconds by plunging a knife transversely through the skin over the crico-thyroid membrane and dividing everything down to and including the membrane. A pair of dressing-forceps is then introduced into the larynx before the knife is removed.

The *after-treatment* of the case will depend on the cause of the obstruction. When it is necessary to employ a tube permanently it is better to perform a high tracheotomy and allow the laryngotomy wound to close.

DIRECT VISION LARYNGOSCOPY, TRACHEOSCOPY, AND BRONCHOSCOPY.

A few years ago Killian showed that it was possible to examine the larynx, trachea, and bronchi by direct vision by means of a rigid tube. The tube can be introduced through the mouth or through a tracheotomy wound. The former is called the 'upper direct method' and the latter the 'lower direct method.'

Instruments.—The instruments required are those known as Brünig's (see Fig. 35). There is an outer and an inner tube, the outer tubes or spatulæ being made of different sizes and lengths and graduated in centimeters, so that the distance that they are introduced can be read off. The inner tube has a watch-spring attached to its upper end, by means of which it can be protruded from the lower end of the outer tube for any desired distance. The spring is marked in centimeters so that the depth it has been passed may be known. This inner tube works in a slot on the internal surface of the outer tube. The illumination is provided by means of a Brünig's hand-lamp (see Fig. 36) or a Kirstein's head-lamp (see

Fig. 38). Both give an almost parallel beam of light and therefore the maximum of illumination. Brüning's lamp is attached by a handle to

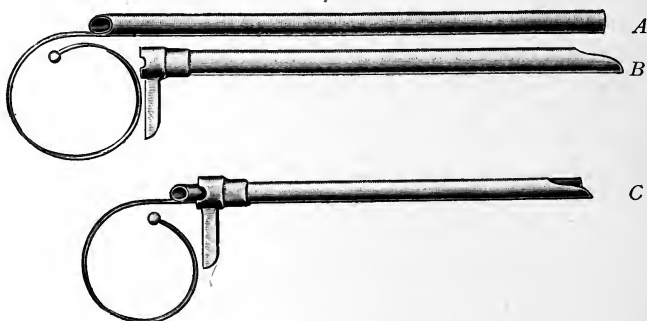


FIG. 35.—BRÜNING'S BRONCHOSCOPE. *A* is the inner tube which is passed down when the outer tube, *B*, is in the trachea. *C* shows one tube within the other; the inner one can be protruded for a considerable distance by means of the watch-spring attached to its upper end.

the outer tube and is so arranged that it can be moved up and down and from side to side, thus allowing the passage of instruments without shutting

off the light. Various kinds of forceps are required for the removal of a foreign body; these are introduced through the tube. An illustration of one of these forceps is shown in Fig. 37. As a quantity of mucus may be secreted during the examination, it is advisable to have a suction apparatus at hand in order to extract it, and also a supply of cotton-wool mops.

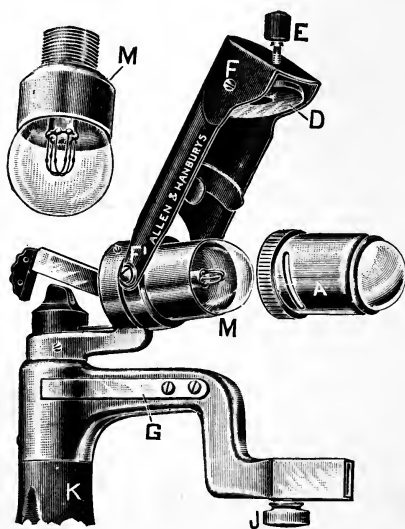


FIG. 36.—BRÜNING'S HAND-LAMP. *K* is the handle of the bronchoscope, the tubes of which are attached to the arm, *G*, by means of the screw, *J*. The lamp, *M*, has a powerful lens, *A*, over it, and its rays are reflected down the tube of the mirror, *D*, which can be set at any angle of the screw, *E*. The hood, *F*, can be swung back to allow instruments to be passed down the tube.

Anæsthesia.—In children, a general anæsthetic is necessary, and cocaine should be used as sparingly as possible. In adults it may be possible to dispense with a general anæsthetic in some cases, especially if the examination is being made through a tracheotomy wound. Chloroform is preferable to ether, as it causes less secretion of mucus. During the whole examination, a careful

watch must be kept on the general condition of the patient; stimulants, oxygen, and tracheotomy instruments should be at hand in case they

are required. Tracheotomy can be done in adults under local anæsthesia (1 per cent. novocaine), and the high operation is better than the low one. The larynx may be cocainised with a 10 to 20 per cent. solution, which should be applied to the larynx, epiglottis, and base of the tongue. For the anæsthetisation of the trachea and bronchi, a 10 per cent. solution should be used. The application of the cocaine is made with small swabs held in suitable forceps.

Position of the patient.—For short examinations, under local anæsthesia, the patient may be in the sitting position; under other conditions the recumbent position is essential, the head being turned to the right and extended or supported beyond the end of the table. The former position is preferable, as it allows the saliva and mucus to escape more easily from the angle of the mouth. Great care should be taken not to over-extend the head, as this position makes the passage of the tube more difficult.

Introduction of the instrument.—*Upper direct method.*—The instrument



FIG. 37.—FORCEPS FOR USE WITH THE BRONCHOSCOPE. These forceps, like the bronchoscopic tubes, can be lengthened by means of the watch-spring.

is sterilised, warmed, and lubricated with liquid paraffin or glycerine. The mouth is widely opened, and the base of the tongue depressed and pushed forwards partly by the instrument and partly by the index-finger of the left hand. The instrument may be passed in the middle line, but it is often easier to pass it from one corner of the mouth. The epiglottis is the first structure to be identified. The instrument is passed over its free border and is then tilted so that the entrance to the larynx becomes visible. By depressing and pressing forwards the distal end of the tube, it is made to enter the cavity of the larynx and is carefully passed downwards into the trachea. The inner tube is placed in position at this stage and pushed downwards in order to examine the lower portions of the air passages. As the tube is passed onwards, the wall of the trachea and the bifurcation come into view. To investigate the bronchi, the handle of the instrument should be displaced to the side opposite to that which is being examined; it is easier to see and examine the right bronchus than the left owing to its size and position.

Lower direct method.—In this method, the examination of the trachea and bronchi is conducted by introducing the instrument through a tracheotomy wound. A general anæsthetic is often necessary and the epiglottis, larynx, and trachea should be cocainised by painting them with a 10 per cent. solution, in order to abolish the reflexes.



FIG. 38.—UPPER DIRECT BRONCHOSCOPY. The head-lamp shown is Kirstein's. (Harner, in *A System of Operative Surgery*, edited by F. F. Burghard.)



FIG. 39.—LOWER DIRECT BRONCHOSCOPY. The head-lamp shown is Kirstein's. (Harmer, in *A System of Operative Surgery*, edited by F. F. Burghard.)

Removal of foreign bodies.—Extraction should be undertaken by suitable forceps as soon as possible; if the foreign body is impacted, attempts should be made to remove it by rotatory movements of the instrument. If it cannot be withdrawn through the tube, it should be brought up as the latter is removed. A careful examination must be made for the foreign body both during the introduction and the withdrawal of the tube, and if not found in one bronchus or its secondary divisions, the other must be carefully investigated. The question of attempting to remove the foreign body by the upper or lower direct method, depends on several factors. If there is dyspnoea, or if the foreign substance is known to be one that can swell when moist, or that is large or has projecting processes such as a tooth-plate, tracheotomy should be done and the low direct method employed. This method should also be used if serious complications are likely to arise during the extraction. Naturally, a good deal depends on the skill of the operator and his ability to carry out the upper direct method. The great advantage of this method is that the patient is generally well in a short time—it may be only a few hours—and that there is no scar on the neck. Any inflammatory conditions which have resulted from the presence of a foreign body usually subside rapidly after it has been removed.

INTUBATION.

By intubation is meant the introduction of a metal tube into the larynx; it is an alternative to tracheotomy in diphtheria and cases in which adhesions are present about the glottis and vocal cords and require stretching. The instruments used are those designed by O'Dwyer (see Fig. 40). The tubes are of different sizes and lengths and are numbered according to the age of the child. Thus No. 1 is meant for a child under one year, No. 2 for a child from one to two years, No. 3 for a child of two to three years, and so on. Larger sizes are made for adults. An introducer and extractor are also supplied, and a piece of silk is fastened to the upper flange of each tube so as to enable the tube to be readily withdrawn if it becomes displaced.

Before introducing the tube, the child is wrapped in a sheet or blanket, so as to fix the arms and legs, and a nurse holds the child upright against her body, while a second assistant is useful to support the head and hold the gag. The tube is sterilised, warmed, and lubricated before use. The surgeon then fits the introducer into the tube. With his left index-finger, the tongue is depressed and the tip of the epiglottis identified, care being taken not to double it back over the glottis. The tube is now passed horizontally backwards to the larynx and then raised vertically, keeping strictly in the middle line. When the tube is over the opening of the larynx, it is gently and firmly pushed downwards by the left

index-finger until its upper end rests on the upper margin of the glottis. The index-finger is kept on the tube while the introducer is being withdrawn. The tube is known to be in the larynx by the fact that the air passes in and out through it. The silk thread is fastened to the cheek by strapping, or tied round one of the ears.

In cases of diphtheria, the tube should not be left in more than a few days; when it is being used as a dilator it may have to be worn for months. The patient should be carefully watched for some time after the introduction of the tube in case difficulty in breathing should arise, as it may be necessary to remove the tube and perform tracheotomy. If the tube enters the œsophagus, it is easily extracted by traction on the silk thread.

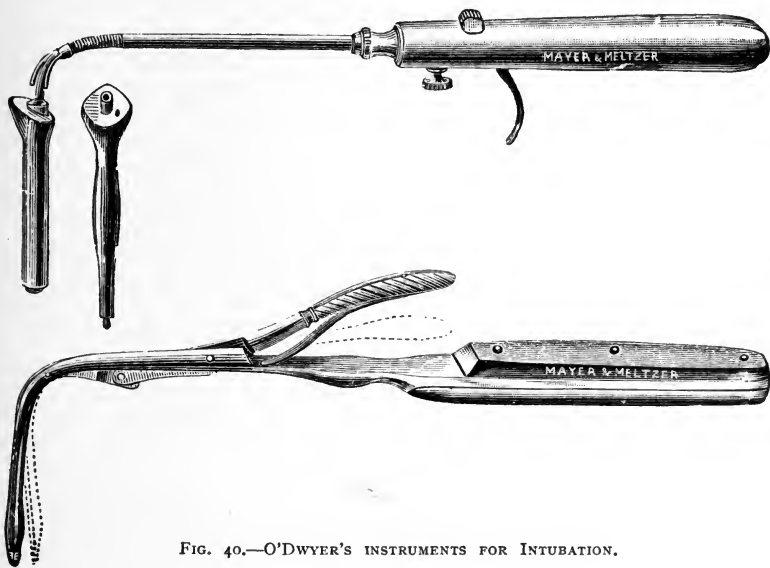


FIG. 40.—O'DWYER'S INSTRUMENTS FOR INTUBATION.

To prevent it from falling into the lower air-passages, as large a tube as will fit the larynx should be used. Should such an accident happen, the tube must be extracted by the means detailed in Chapter XI. It is not uncommon for the tube to be expelled by coughing or vomiting, and in diphtheria it may become blocked by the membrane. Under these circumstances it must be removed at once.

In order to remove the tube, the child is held in the same manner as during its introduction, and the closed blades of the extractor are passed into the upper end of the tube. The blades are then opened and kept open, so as to exercise pressure on the circumference of the lumen of the tube whilst the extractor is withdrawn. The tube may also be removed by pulling on the string, guided by the left forefinger passed down to the upper end of the tube.

The question of intubation or tracheotomy for diphtheria has been much

debated. We prefer the latter procedure, and it is important to remember that in many patients who have been successfully intubated, tracheotomy has been necessary at a later period. Apart from the difficulties in introducing the tube, it may be coughed out in a very short time or it may become blocked. The patients require more careful watching than after tracheotomy, and swallowing is often difficult, liquids being very likely to pass into the trachea. Unsuccessful attempts to introduce the tube may cause considerable damage to the larynx. After intubation, granulations may form and stenosis of the larynx may result.

CHAPTER XIII.

CANCER OF THE LARYNX.

EPITHELIOMA may commence primarily in the larynx or may spread to it from the surrounding parts, such as the pharynx or the base of the tongue ; when it is primary in the larynx, it usually commences about the base of the epiglottis or in the neighbourhood of the vocal cords. In the latter situation it is generally unilateral at first, but it soon spreads to the other side. It infiltrates the submucous tissue, attacks the cartilages, and, if situated near the posterior part, invades the arytenoids and affects the pharynx. When it reaches the pharynx, or penetrates the cartilages, glandular infection soon occurs, but as long as the disease remains limited to the larynx, the glands may be unaffected. Glandular carcinoma may also be met with and sometimes sarcoma ; the latter usually begins in the infra-glottic region. The most valuable classification of cancer of the larynx from the point of view of treatment is into *intrinsic* and *extrinsic* growths.

Intrinsic growths are those in which the vocal cords and ventricular bands, or the parts beneath them, are involved. In this situation the growth increases slowly and has little tendency to spread beyond the limits of the larynx, while glandular involvement is rare and only occurs late in the disease ; secondary growths are almost unknown. Owing to the situation of the growth, hoarseness develops soon and is followed by dyspnoea, so that attention is drawn to the condition at an early stage and consequently early treatment becomes possible.

Extrinsic growths of the larynx are those involving the epiglottis, the arytenoids, or the aryteno-epiglottic folds. They may commence in these parts or may spread from the neighbourhood, especially from the lateral or anterior wall of the pharynx. Glandular enlargement occurs early ; not uncommonly a large hard mass of malignant glands in the neck is the first thing that attracts the patient's attention, and the case often comes under observation too late to admit of radical treatment.

The *symptoms* are often most distressing. There is at first much hoarseness and cough, and, later on, when the growth reaches the pharyngeal

mucous membrane, there is severe dysphagia. Spasm and dyspnœa are common when one or both cords are implicated, and free hæmorrhage is not infrequent. The death of the patient is generally due to septic pneumonia, but may occur from weakness, from asphyxia due to blocking of the air-passages by the growth, or from hæmorrhage.

TREATMENT.—Of **intrinsic laryngeal cancer.**—If the case seems otherwise suitable for operation, a piece of the growth should be removed with laryngeal cutting-forceps, aided by the laryngeal mirror, for microscopical examination so as to verify the diagnosis; this should never be done, however, unless the surgeon intends to follow it up by extirpation, as it usually excites increased activity of growth.

In carcinoma all intra-laryngeal methods of removal may be at once condemned as inefficient; the choice must lie between thyrotomy and complete extirpation of the larynx. When the growth involves both sides of the larynx extensively and the patient seems a suitable subject for a major operation, *extirpation of the larynx* may be undertaken. If the growth is small, and especially if it is limited to one side of the larynx, *thyrotomy* may be performed. It is better to prepare the patient for the major operation and then to open the larynx and proceed according to what is found.

The most important complications of thyrotomy and laryngectomy are those due to sepsis—namely, cellulitis, septic pneumonia, or acute septicæmia; there is also the risk of blood getting into the trachea during the operation, and either causing asphyxia or setting up pneumonia subsequently. The danger of local sepsis, although it cannot be entirely avoided, may be minimised by adopting the preliminary precautions already recommended for all operations of this kind (see Vol. IV. p. 79). The dangers arising from the passage of blood into the trachea are avoided by the means described on p. 153.

Thyrotomy.—This operation is followed by extremely good results in suitable cases, both with regard to the question of non-recurrence and also with regard to that of articulation, the patient retaining a perfectly satisfactory though somewhat hoarse voice. In most cases of intrinsic cancer of the larynx, the operation should commence with a thyrotomy. This allows adequate inspection of the interior of the larynx and the surgeon is able to determine the best course to pursue. Before it is undertaken, however, the position of affairs must be explained to the patient, and the surgeon should have leave to do whatever is necessary. We have in several cases been agreeably disappointed in finding after thyrotomy that the disease was more local than the symptoms and appearances had indicated.

As regards the anæsthetic, chloroform is the one most generally suitable. When the Trendelenburg's or Hahn's tube has been introduced, the anæsthetic can be administered through a tube attached to the canula, and thus the anæsthetic does not get into the way of the

operator. Some surgeons use the intravenous administration of hedonal or ether in these cases, but there is always a great risk of septic discharges finding their way into the lungs during the prolonged recovery period and causing septic pneumonia.

Before opening the larynx, tracheotomy should be performed and the trachea blocked by the insertion of a Trendelenburg's or Hahn's canula (see Fig. 21).

Hahn's tube is prepared as follows : The tube is first boiled, and then a piece of firm flat sponge, which has lain for some days in 1 in 20 carbolic lotion, is squeezed dry, soaked in a 10 per cent. ethereal solution of iodoform, and wrapped firmly around the tubing. The opposed surfaces are stitched together and a piece of sterilised tape is finally wound tightly round the sponge so as to compress it. The whole is then dried. The tape is removed before the tube is introduced into the trachea ; it must not be moistened before introduction. Time must be allowed for the sponge to swell after the canula has been introduced into the trachea before proceeding with the operation on the larynx ; five to ten minutes will suffice.

Some surgeons advocate that the tracheotomy should be done some days before the thyrotomy, so that the patient may be relieved of any laryngeal obstruction present, and thus be in a better condition to stand the operation. It is further urged that the trachea becomes accustomed to the tube and that there is thus less coughing and bronchitis, whilst the length of time occupied by the main operation is diminished and the shock is consequently less. We have adopted both plans, and we are in favour of performing the tracheotomy immediately before proceeding to the removal of the disease by thyrotomy.

We generally open the trachea at the level of the isthmus of the thyroid gland, which is divided and held apart, an operation intermediate between a high and a low tracheotomy. This leaves sufficient room above for the necessary operation upon the larynx, whilst the trachea is not so deeply situated as in the low operation and the tube is more easily managed. When the operation is divided into two stages, an ordinary tracheotomy tube is introduced at the time, but the opening in the trachea should be made large enough to admit of the insertion of a Hahn's or Trendelenburg's canula at the second operation, as it is not advisable to perform any further cutting operation on the trachea at that time.

A median vertical incision is now made, commencing at the upper border of the hyoid bone and ending at the lower border of the cricoid cartilage ; this incision is carried right down to the cartilages. The tissues are dissected off the thyroid cartilage for about half an inch on each side of the middle line and the flaps held aside. A small superficial transverse incision is made in the thyroid cartilage about its centre,

so as to indicate the proper position for reuniting the two halves at the end of the operation, and the cartilage is then split vertically in the middle line. Should this structure be partially ossified, the crico-thyroid membrane is opened, and the cartilage is split vertically by introducing one blade of a pair of special shears beneath it in the middle line. The two halves of the cartilage are then retracted and the interior of the larynx is exposed; should the exposure be insufficient, short transverse incisions may be made in the crico-thyroid and thyro-hyoid membranes. A small piece of sponge fastened to a stout thread, may now be packed into the upper end of the trachea above the Hahn's tube, so as to make still more certain that blood does not get into the trachea, and the further operative procedure is decided on. The decision will depend on the size and situation of the growth, and if this is limited to the larynx and not firmly adherent to the cartilages, an internal operation will suffice. A 10 per cent. solution of cocaine is applied to the mucous membrane and the surface of the growth in order to lessen the hæmorrhage and abolish the sensibility of the larynx. An incision is then made through the mucous membrane around the growth and half an inch away from it and carried down to the cartilage. The perichondrium is raised with an elevator and the diseased area removed.

When the disease is limited to the vocal cords and has not penetrated to the cartilages, it is not absolutely necessary to strip off the perichondrium; but this does no particular harm and makes the result more certain. The bleeding is usually slight and stops on pressure. After it has been arrested, the sponge is removed from above the Hahn's canula, which by this time will have swelled sufficiently to block the trachea, and it is well to leave the canula in position for a few hours until the oozing has stopped.

The two halves of the thyroid cartilage must be united accurately by catgut stitches. This is generally easy and there is little tendency to displacement afterwards. The infra-hyoid muscles are next brought together by sutures, the skin incision completely closed, and the patient put back to bed. The Hahn's canula is replaced by an ordinary tracheotomy tube in six or eight hours, and this may be left out after twenty-four hours and the wound allowed to close. Unless the incision involves the arytenoids or the aryteno-epiglottidean folds, the patient can swallow well and may be fed by the mouth. It is advisable not to give nourishment by mouth till the day following the operation, and the power of swallowing should be first tested by asking the patient to drink water with the head bent forwards. If none escapes by the tracheotomy wound, liquids may be given. There is often considerable coughing during healing, but this passes off, and the result is usually satisfactory. The patient may sit up at the end of a week. If any granulations appear in the wound or in the anterior commissure, they should be removed and examined microscopically to determine if there is any recurrence.

Complete laryngectomy for intrinsic cancer.—Complete laryngectomy may seem desirable in cases of intrinsic cancer under two sets of circumstances. For example, the surgeon may come to the conclusion before operation that a thyrotomy will suffice for the removal of the disease, but on proceeding with the operation, he may find that the cancer is more extensive than he expected and that the disease cannot be completely taken away if the box of the larynx is left. Under these circumstances he has no alternative but to proceed at once to the operation of laryngectomy. To abandon the operation after having opened the larynx and made an attempt to remove the disease is inadvisable.

Again it may be evident at once on examination of the case that a thyrotomy with local removal of the growth will not suffice, although the disease is still confined to the interior of the larynx. Under these circumstances, laryngectomy is the only feasible operation and the patient may rightly be advised to have it done. In both these cases there is a fair chance of non-recurrence of the disease—at any rate, for a considerable time. Certain preliminary points may be mentioned in connection with the operation.

As regards the *anæsthetic*, chloroform is the best; and as soon as the trachea has been divided and fixed to the skin, an ordinary tracheotomy tube is inserted and the anæsthetic given by a Junker's apparatus, the tube being held over or inserted into the tracheotomy tube. Ether and hedonal have also been employed intravenously, but there are objections to the method, which have been already referred to (see p. 153). Local anæsthesia is also employed by some.

The *position of the patient* is of importance, more especially with reference to the prevention of blood and discharges passing down the trachea. A good view of the field of operation is obtained by raising the shoulders on a large sand-bag and letting the head hang back, the head of the table being lowered if necessary; in this position most of the blood runs into the pharynx. Keen suggested some years ago that the Trendelenburg position should be adopted in operations about the pharynx and larynx, and though it is not very satisfactory in pharyngeal operations and in thyrotomy where the aryteno-epiglottic folds are intact, and though there is more bleeding, it keeps the field of operation very free from blood in complete laryngectomy. In that operation, however, the trachea is divided and attached to the skin below the wound before the larynx is removed, and there is no special risk of blood passing down the trachea if the head is thrown well back.

Although as a rule no noticeably *enlarged glands* are present in intrinsic cancer of the larynx, nevertheless, when the condition is such as to require a complete laryngectomy, it is probable that the glands are becoming infected and therefore they and the fat in both anterior triangles should be thoroughly removed. When complete laryngectomy is found to be necessary, during the course of a thyrotomy, the glands must be removed

at the same time as the laryngectomy is performed, but when it is clear before the operation is undertaken that laryngectomy will be required, it is well to divide the operation into two stages, removing the glands in the first instance and carrying out the laryngectomy a week or so later. In these cases the whole triangle should be cleared out down to the clavicle. The method of removing glands in this situation is described in Vol. IV. p. 101.

The *operation* of complete laryngectomy is performed as follows: A vertical incision is made in the middle line of the neck commencing above the upper border of the hyoid bone and extending down to about an inch below the lower border of the cricoid cartilage. Transverse incisions are carried outwards for about two inches on each side from the upper and lower ends of this incision, and the two flaps thus formed are turned aside. The laryngeal muscles and fascia are then turned aside, care being taken to leave the perichondrium with the larynx.

After the front and sides of the larynx have been cleared and the attachment of the pharynx defined, attention is directed to the trachea. An incision (vertical or transverse) is made just above the supra-sternal notch and deepened between the muscles down to the trachea, and the bridge of skin, muscles, and fascia is lifted up from the front of the trachea with the finger. The trachea is now cut across just below the cricoid cartilage, seized with forceps and pulled out through this opening; in order to enable the trachea to come forward easily and without any kinking, it may be necessary to divide the isthmus of the thyroid gland. The open end of the trachea is cut obliquely if necessary so as to make it lie flush with the surface of the skin, to which it is attached by interrupted sutures of silkworm-gut. The trachea should be divided as near the cricoid as possible and brought out through a skin-opening made as low down as possible so as to compensate for the downward pull of the lungs when the support of the larynx is lost.

The lower end of the cricoid cartilage is now seized with forceps and the pharynx peeled from the back of the cartilage with a blunt dissector, great care being taken not to tear a hole in the pharynx in so doing. When there is no reason to believe that the disease has attacked the posterior part of the cricoid cartilage, this accident may be avoided by peeling up a little of the perichondrium to which the lower constrictors of the pharynx are attached. The detachment of the pharynx is carried up to the upper part of the cricoid cartilage (unless it is found that the disease has after all spread outside the larynx) and the pharynx is then opened by dividing it transversely.

The thyro-hyoid membrane is now divided from the front, and the epiglottis is cut across at the same level, unless it has become affected, when it is completely removed. The aryteno-epiglottidean folds are divided, and the larynx is removed with a few snips of the scissors. Care should be taken at this stage not to remove more mucous

membrane than is absolutely necessary, as it is often difficult to close the opening without stenosis of the pharynx.

The question now arises as to the best way of dealing with the large gap left after removal of the larynx. Two methods may be adopted: one being to close the pharynx completely and the other to leave a portion open for the subsequent reception of a speaking-apparatus.

When it is decided to close the opening into the pharynx this is best done by approximating the mucous membrane of the anterior wall of the pharynx to the base of the tongue, thus making the deep line of sutures transverse. In the first instance the mucous membrane is brought together by a continuous catgut suture, the edges being turned in so as to apply the raw surfaces to each other. Over this the muscular and fascial structures are brought together vertically by a continuous catgut stitch, and finally the skin is sutured vertically. It is well to insert a small drainage tube through a separate button-hole opening on each side, the tubes running transversely beneath the skin on a lower level than that of the transverse suture in the pharynx, so that, should the opening in the pharynx give way, the discharge may not accumulate beneath the skin-flaps and give rise to suppuration. If pus forms beneath the flaps it is very difficult to prevent it from running into the trachea. Gauze dressings are applied so as to exercise a certain amount of pressure on the skin-flaps above the opening of the trachea and thus keep them in contact with the deeper parts.

After-treatment.—It is well to employ rectal feeding for the first two or three days, and then the patient may be fed by a tube passed through the nose and—preferably—left in for two or three days, or passed on each occasion. If the union holds, the patient may try to swallow in about a week; if not, feeding by a tube must be continued until the wound has healed. If an opening persists, the patient can close it by packing, or by some apparatus, when he wants to swallow. No tracheotomy tube is necessary.

The result of this operation is very satisfactory in many respects and the mortality is slight. When the opening has completely closed, the patient can swallow comfortably and breathe freely through the trachea, and with a little practice he can learn to whisper sufficiently to make himself understood. Some patients, however, become very depressed on account of the loss of voice; but if this is the case, it is possible to establish an opening into the pharynx after the wound has healed and fit a speaking-apparatus between it and the trachea. If, however, that is done, the patient may be worried with dribbling of saliva through the opening, and with difficulty in swallowing, and it is a question whether this condition or the absence of a satisfactory voice is the more disagreeable.

In the other operation *the opening in the pharynx is only partially closed*, space being left for the adjustment of a speaking-apparatus. Here it is best to leave the rest of the wound open, pack it with gauze

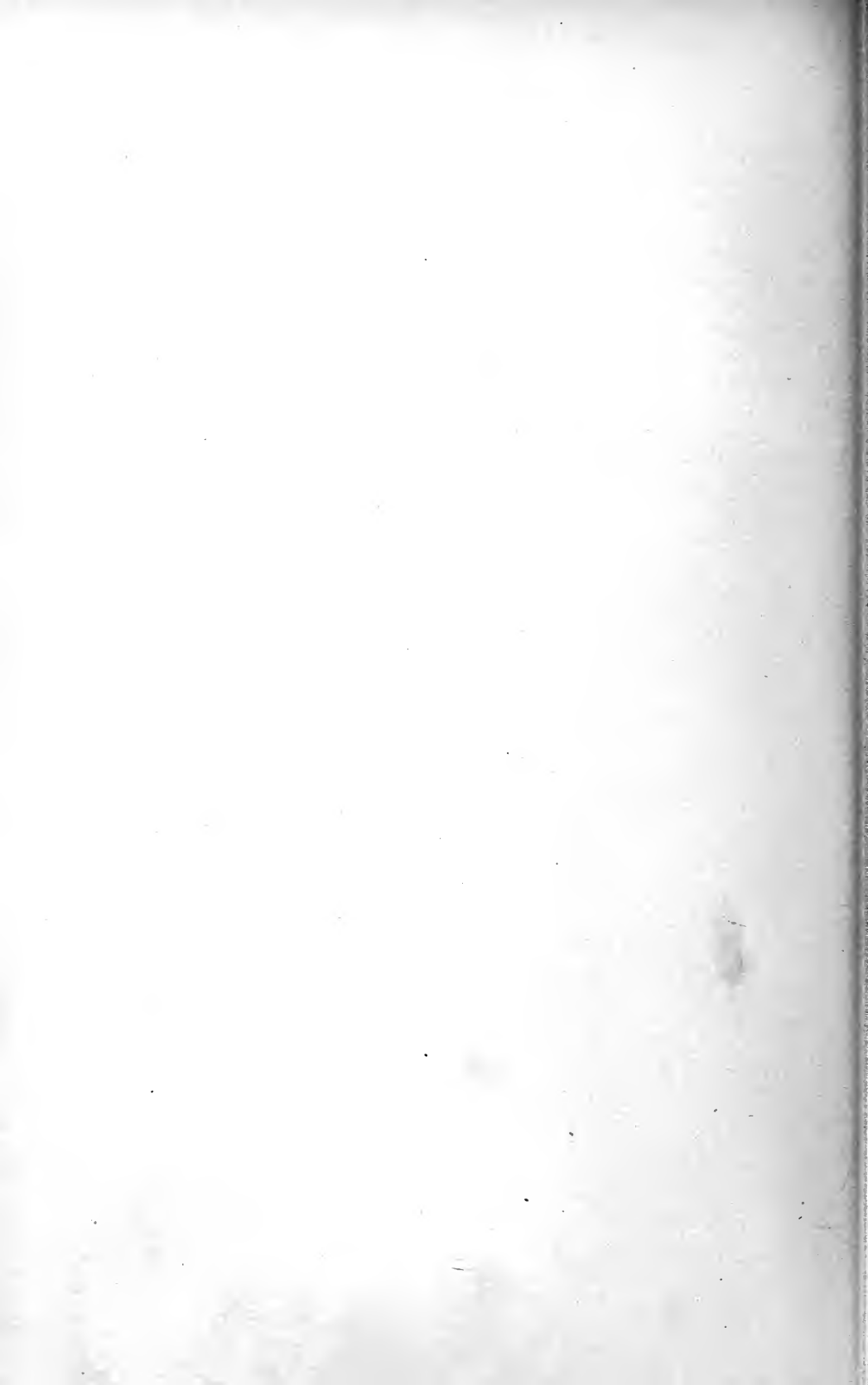
for a time, and allow it to heal by granulation. The patient is fed by an œsophageal tube for a long time. The mortality after this operation is a good deal higher than after the other on account of the septic wound and also of the risk of the pus running into the trachea; there is constant dribbling through the opening into the pharynx, swallowing is difficult, and the only advantage is the presence of the speaking-apparatus; this, however, can be fitted in the other case if desired (*vide supra*).

Formerly, *removal of one half of the larynx* was advised in cases in which the cancer was limited to one side, but the operation seems quite unsuitable for various reasons. It has been found that a good many of the cases in which this operation was recommended can be successfully dealt with by thyrotomy and local removal, while in others removal of one half the box of the larynx is not sufficient. Further, it is the most dangerous of all these operations because a direct communication is left between the pharynx and trachea and it is almost impossible to prevent the pus running down the latter. Lastly, the contraction of the wound narrows the breathing-space considerably.

Of extrinsic laryngeal cancer.—Here the conditions are quite different because the disease is no longer limited to the interior of the larynx, but has spread to neighbouring parts—the pharynx, epiglottis, and cervical glands. The result is that a much more extensive operation is required. In all cases complete laryngectomy is necessary, but in addition to that, portions of the pharynx must be taken away, and extensive dissection is required for the removal of diseased glands in the neck. The operation is a very severe one and the mortality is great. The chances of non-recurrence are extremely small; in the great majority of cases immediate recurrence takes place. Further, the condition of the patient after these operations is pitiable in the extreme; a great gap is often left in the situation of the pharynx, the patient has to be fed through an œsophageal opening, and breathes through the upper end of the trachea. As a surgical feat, a case which recovers may appear remarkable for a short time, but as a method of treating the patient these operations are as a rule useless and inadvisable. It is only in a very few cases in which the extension to the pharynx is very limited and the glandular infection slight that operation need be considered; in most cases the patient is much better off with a simple tracheotomy. The operative procedures cannot be described, as they must vary with the distribution of the disease, but they consist in complete laryngectomy as described above and removal of portions of the pharynx (see Vol. IV. p. 155) along with extensive removal of glands.

Palliative.—Should the patient decline operation or should the case be unsuitable, palliative measures must be adopted. These consist in the administration of suitable food, the relief of pain, and the performance of tracheotomy as soon as dyspnoea occurs. The pain and dysphagia may be relieved by the insufflation of *orthoform*. This powder

is non-poisonous, and therefore the surface of the growth may be freely dusted with it. It usually gives relief from pain for a few hours, and then the insufflation should be repeated; its application may be entrusted to a trained nurse. Should it fail, the pain must be relieved by the administration of opium or morphine. The difficulty in swallowing may sometimes be diminished by posture. The patient can often swallow soft solids or thickened fluids better than liquids, as the latter are apt to enter the larynx and excite spasm; in extreme cases food must be administered *per rectum*, or a gastrostomy must be performed. When dyspnœa is present from stenosis of the larynx, *tracheotomy* must be done, the trachea being opened as low down as possible in order that the tracheotomy wound may not become involved in the growth subsequently.



DIVISION III.

THE SURGICAL AFFECTIONS OF THE BREAST AND THORAX.

SECTION I.—AFFECTIONS OF THE BREAST.

CHAPTER XIV.

DEFORMITIES, INJURIES, INFLAMMATORY AFFECTIONS, TUBERCULOSIS, AND SYPHILIS OF THE BREAST.

DEFORMITIES.

THE only congenital deformity of the breast amenable to surgical treatment is the so-called 'umbilicated nipple'; a similar malformation may arise after puberty when a large amount of fat develops in the breast. In this condition the nipple lies buried at the bottom of a circular fossa, and in marked cases may give rise to much trouble from the accumulation of dirt, epithelium, and secretion. As a rule, however, the depression is not great and the deformity only requires treatment because of the possible difficulty in suckling.

TREATMENT—The minor forms of this condition can be remedied by removing a crescentic area of skin on each side of the nipple, with its concavity towards the latter and sufficiently wide to obliterate the fossa between the skin and

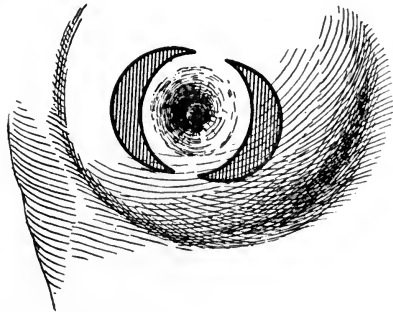


FIG. 41.—PLASTIC OPERATION FOR 'UMBILICATED NIPPLE.' The crescentic shaded areas represent the portions of skin removed. The inner and outer edges of the crescents are sewn together.

the nipple when its edges are sewn together (see Fig. 41). When the nipple lies buried at the bottom of a deep pit, this operation does not usually suffice, and the treatment will depend on the age of the patient and the amount of trouble that the condition is causing. When the patient is in the childbearing period, it will be best to do nothing unless ulceration is present. Under the latter circumstances, and also if ulceration occurs at a later period of life, it may be advisable to excise the nipple and areola or to amputate the breast if there is any suspicion of malignancy.

HYPERTROPHY.

This condition is not at all uncommon, and one or both breasts may occasionally reach an enormous size; it is said that sarcoma of the breast not infrequently follows it. Care must be taken not to confound the enlargement of the breast due to chronic mastitis or the presence of a tumour—such as a large fibro-adenoma—with a simple hypertrophy.

TREATMENT—When the breast has reached a size that makes it a source of great inconvenience to the patient, there is nothing for it but to amputate the organ, as no treatment will bring the hypertrophy to a standstill.

INJURIES.

These require treatment on ordinary principles. Contusions of the breast may set up chronic mastitis, and in some cases the history seems to indicate that malignant disease has followed directly upon injury; a hæmatoma may also suppurate. If the blood does not become absorbed soon, incision and drainage may be necessary.

INFLAMMATORY AFFECTIONS.

Inflammatory affections of the breast may be acute or chronic and may originate in the nipple or in the breast tissue itself.

INFLAMMATION OF THE NIPPLE.

Cracks and fissures and so-called 'chapped nipples' are common during lactation, and are often associated with slight malformations of the nipple necessitating increased efforts on the part of the child in sucking. Imperfect attention to the toilet of the nipples after suckling the child is also probably an important cause, as cracked nipples are very liable to infection, especially when the infant suffers from an aphthous mouth or purulent ophthalmia. Various micro-organisms—the most frequent

being streptococci and the coccus of erysipelas—easily find entrance through these cracks.

The fissures are generally multiple, and radiate from the centre of the nipple; they may be limited to the nipple, but more commonly they extend on to the areola. They give rise to intense pain, which is set up by the slightest touch; they bleed readily and soon become infected, and the child in suckling may swallow not only blood but pus.

TREATMENT.—The prophylaxis is most important. If the skin is tender or the nipple deformed, the patient should either avoid suckling altogether or should not suckle the child too frequently, and the parts should always be thoroughly washed with boric lotion afterwards and then carefully dried and dusted with boric powder, which must be wiped away before the child again takes the breast. When fissures are actually present, suckling should be abandoned, but, if the mother refuses to do this, the next best thing is to employ a suitable shield to fit the nipple, through which the child may suck without much risk. In the intervals between suckling, the fissures should be bathed with antiseptic lotions—such as boric acid or boro-glyceride; or a paint composed of sulphurous acid (3ij), glycerine of tannic acid (3ij), and water (3j) may be applied. If the fissures do not heal under this treatment, lotions of sulphate of zinc or copper (gr. ij ad 3j), may be employed, or the fissures may be touched with solid nitrate of silver; under these circumstances, suckling must be abandoned. Should septic infection occur, the fissure becomes more tender, red lines spread from it towards the axilla, and the axillary glands become enlarged; small abscesses not uncommonly form along the course of the lymphatics, especially beneath the areola, and the general symptoms of lymphangitis are present. The treatment is that for lymphangitis (see Vol. II.).

ACUTE MASTITIS.

This affection may make its appearance in infants almost immediately after birth, especially when the breast is squeezed vigorously as is frequently done by ignorant persons; under such circumstances inflammation and suppuration may take place. In other cases suppuration may not occur, but the inflammation interferes with the proper development of the organ, especially of the nipple. Acute mastitis may also occur at puberty, but is then usually non-suppurative. Suppuration is most common, however, during lactation, especially in primiparæ; it may also occur at the end of lactation. In a large number of cases sore nipples have preceded the formation of the mammary abscess and the infection has originated from them, the organisms having entered either along the lymphatics or, perhaps more commonly, along the lactiferous ducts; in other cases a general septicæmic condition is present and the organisms may be deposited from the blood.

TREATMENT.—In adults, *prophylaxis* is very important ; the breast should be washed with boric lotion each time after suckling the child. Attention must be paid to the cleanliness of the linen and to the condition of the mouth and eyes of the infant, and special precautions must be taken should any crack or excoriation of the nipple exist (see p. 163).

Before suppuration is evident, the breast should be well supported by a breast-bandage in which the turns pass alternately over the opposite shoulder, and around the thorax (see Fig. 42) ; or, if it be very tender, it may be slung up by a large bandana handkerchief, or the special arrangement shown in Fig. 43 may be employed. The arm should be fixed to the side, and, in mothers, suckling should be entirely discontinued. Fomentations and the local measures for the relief of acute inflammation

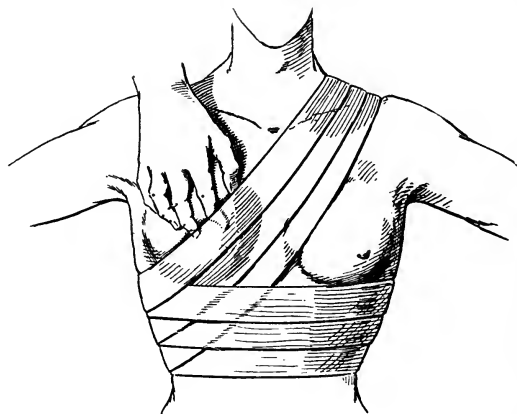


FIG. 42.—BREAST-BANDAGE. The breast is pulled firmly upwards while a bandage is applied with turns going alternately over the opposite shoulder and round the trunk.

should be employed (see Vol. I. p. 4). In children and babies, the breast should be protected by a thick layer of cotton-wool kept in position by means of a breast-bandage, or a large collodion dressing may be applied.

When pus has formed—as will be evident from the œdema and redness of the skin, from the length of time that the inflammation has lasted, or from the presence of fluctuation—the abscess should be opened. It is important that all the recesses of the abscess cavity should be drained, and the patient should be placed under a general anæsthetic for the purpose. A free incision should be made in a line radiating from the nipple, and the finger introduced so as to break down any septa that may cross the abscess cavity ; these are particularly numerous in the breast, as the pus burrows among the ducts and lobules. A large drainage tube should be inserted. It is useless merely to make an incision through the skin at the spot where the abscess is pointing without opening up the

recesses in the cavity, as fresh abscesses and sinuses will almost certainly form. More than one incision may be required when the abscess has burrowed widely; in these cases a tube should be placed in each incision.

Superficial suppuration may also occur in connection with a lobule of the breast; a small abscess forms between the breast and the skin and bursts through the latter if left alone. Abscesses of this type are not infrequently close to or beneath the areola. Incision and drainage will lead to rapid healing.

It is not uncommon for a patient to present herself with a number of *sinuses* in the breast resulting from an abscess which has been imperfectly opened and drained. These sinuses will not heal unless they are opened up and the breast may become so disorganised as to be

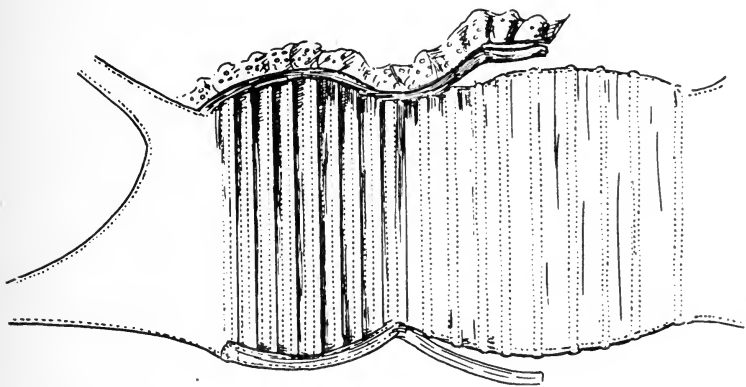


FIG. 43.—BREAST-SUPPORT. The sketch shows how the apparatus can be made to give proper support to a breast of any size by varying the relative lengths of the upper and lower borders.

useless. Each sinus should be enlarged and the finger introduced so as to see that there is a free communication between the various sinuses and that every recess is drained. Tubes should be passed through from sinus to sinus or into any recess. Syringing the sinuses is inadvisable; the drainage tubes can gradually be shortened and withdrawn and the sinuses heal one by one. When, however, the breast is completely riddled with sinuses, amputation of the gland may be the better treatment.

SUB-MAMMARY ABSCESS.

Acute abscesses may form deep in the breast and spread into the cellular tissue beneath it instead of travelling towards the surface; these give rise to the *acute sub-mammary abscess*. A similar condition may follow injuries, strains of the arm, or a hæmatoma which has suppurated. In these cases the breast is raised *en masse* and projects

forwards as an unduly conical organ ; in the early stages, at any rate, the skin over it though hot is not reddened. The symptoms of acute inflammation are present, and œdema of the tissues around the base of the gland occurs ; when this condition is found, the presence of pus is fairly certain. The actual detection of suppuration is not easy so long as the pus is confined beneath the gland, and the best way of obtaining fluctuation is to place the fingers of one hand below and to the outer side of the organ, and then sharply depress the gland as a whole.

Chronic sub-mammary abscesses are fairly common. They usually arise in connection with a tuberculous deposit beneath the organ, frequently in the ribs themselves, and form fluctuating swellings beneath the mamma which if left alone tend to point at the lower and outer edge of the breast.

TREATMENT.—*In acute cases* the pus should be evacuated by an incision at the lower and outer part of the gland—the situation where it usually points. The cavity is explored with the finger and thoroughly drained.

The treatment of the *chronic tuberculous form* is similar to that for chronic abscess elsewhere, and if it is connected with tuberculous disease of the ribs the abscess wall should be dissected out and the affected area of the bone taken away (see Chap. XVIII.). The best way of exposing the tuberculous focus beneath the breast is to make a curved incision along the lower and outer margin of the gland and turn it bodily upwards. This gives plenty of room to deal with the abscess and to resect the affected portion of the rib. After the operation the breast is replaced and the wound is stitched up.

CHRONIC MASTITIS.

This condition is quite common, and occurs in two principal forms. In the one the inflammation is limited to a portion of the breast, where it may form a tumour of considerable size : this is the *chronic lobar mastitis*. In the other, the inflammation attacks numerous lobules, and after a time the breast acquires a granular feel from the thickening thus produced ; this condition is termed *chronic lobular mastitis*, and it may affect only one or two lobules, but is usually diffused over the breast and is frequently present on both sides simultaneously.

(a) **CHRONIC LOBAR MASTITIS.**—The majority of these cases follow injury or lactation, particularly at the weaning period. When the affection follows injury, it is probably due primarily to a localised hæmorrhage, but it may be the result of repeated slight injuries in large heavy mammæ or of undue pressure—as for example, by tight corsets or from playing an instrument, such as the mandolin, which presses upon the breast. In some cases the condition is tuberculous.

There is usually comparatively slight, vague, and variable pain. On examination, a sensitive nodule may be detected, the outlines of the mass

being diffuse and the swelling itself firm and elastic ; this enlarges slowly as long as the original cause is in action. The thickened part moves with the rest of the breast and there is no adhesion to the skin unless suppuration occurs. The axillary glands may be unaffected, but they may be enlarged and tender. Suppuration occasionally occurs, and in that case the pain and tenderness become more acute and the skin may become adherent to the inflamed breast. These cases are sometimes difficult to diagnose, and are often confounded with cancer of the breast or *vice versâ*. In cancer, however, the skin becomes pulled upon at a comparatively early period, without any of the signs of inflammation, and puckers when an attempt is made to push it gently up from the tumour, or an actual dimple is found due to the pull upon the suspensory ligaments of the breast which are involved in the cancerous growth. Carcinoma is also more defined and harder, and usually forms a prominent mass under the hand when the palm presses the breast flat against the ribs, whereas in chronic mastitis no definite hard mass is felt on doing this, even when a tumour may be apparent to the fingers. Chronic mastitis usually occurs in younger subjects than those liable to cancer, and the pain is comparatively slight and is not stabbing in character. There is some ground for believing that this condition, though innocent at first, may lead to the development of cancer.

Treatment.—The breast should be supported by a handkerchief or, still better, by a breast-support (see Fig. 43), and all causes of pressure or friction should be removed. The arm on the affected side should be kept in a sling, and in bad cases even fastened to the side at first. If there is much pain, belladonna ointment or glycerinum belladonnæ may be smeared over the breast, but the best treatment is probably a succession of hot fomentations or poultices. The induration takes a considerable time to disappear ; as soon as it begins to improve, pressure—best applied by strapping the breast—will promote its absorption. The organ should be supported, and strips of strapping about two inches wide are firmly applied from below upwards, beginning over the sternum in front and extending well behind the posterior axillary line.

If there is the least doubt as to the nature of the swelling, or if it does not yield to treatment, the best plan is to cut down upon and remove the thickened mass ; for, after all, this is the most effectual way of getting rid of the inflammatory area, while, if the mass proves to be cancerous, the diagnosis is made at a comparatively early period. We prefer to excise the swelling rather than cut into it, because if a simple incision is employed and if the tumour turns out to be malignant, there is a risk of diffusing the cancer-cells over the wound. It is always desirable, in these doubtful cases, to have a skilled pathologist present at the operation who can make a rapid section of the tissue removed and at once determine whether there is any malignant disease ; if so, the operation

for such disease may be undertaken forthwith. If the mass is not malignant, it will suffice to remove the thickened part of the breast and leave the rest; the remaining portions of the breast may be brought together by catgut stitches, and in all cases a drainage tube should be inserted for three or four days, otherwise a hæmatoma is almost certain to form.

(b) **CHRONIC LOBULAR MASTITIS.**—This form of the affection may occur at any age and bears no definite relation either to lactation or to injury. It is perhaps more common in multiparæ who are approaching the climacteric period, but it may also occur at puberty, and the nodules always tend to increase in size during menstruation. It is usually bilateral, but is commonly more advanced in one breast than in the other, and as a rule is only noticed by accident.

The breast is generally enlarged, and on palpation is found to have lost its soft, elastic character and to be unduly firm. If pressed against the thorax it feels granular, with numerous small nodules scattered throughout its substance; the axillary glands may be somewhat enlarged though they do not form the hard masses found in carcinoma. Occasionally there is considerable pain, giving rise to the condition known as *mastodynia*, which is probably due to involvement of nerve-endings; when this occurs, the patient suffers from neuralgic pains beginning in the breast and radiating towards the neck, shoulder, and back, often coming on in severe crises and generally worse before the menstrual period.

The condition is usually readily diagnosed, the only difficulty being to distinguish it from multiple cystic disease of the breast, of which it is probably merely the early stage.

Treatment.—There is comparatively little to be done; as a rule, it is sufficient to protect the breast from injury, to support it, and to employ compression by applying strapping and a bandage firmly over a large mass of cotton-wool. For the relief of pain, a belladonna plaster or glycerinum balladonnæ may be indicated, and sometimes the application of X-rays or the continuous current is beneficial.

Some surgeons look upon this condition—especially when multiple cystic disease has developed—as a sort of epitheliomatous affection, or, at any rate, as a precursor of cancer, and advise total excision of the breast. This view is, however, purely theoretical, and it does not seem justifiable to remove the breast in all these cases. A free excision of the breast may, however, be advisable when severe mastodynia is present and the patient fails to derive benefit from local applications, provided that the condition of the pelvic organs reveals no cause for the pain. Even after removal of one breast, however, the neuralgic pain is apt to persist on that side or to appear in the opposite breast, and therefore a very cautious prognosis must be given.

The breast may be removed in these cases subcutaneously by making an incision along the lower and outer border. It is separated from the

pectoral fascia by raising it along with the layer of loose tissue which separates the breast and fascia. The skin is dissected off the superficial aspect of the breast, taking care not to damage the nipple. It will of course be necessary to sever the ducts passing to that structure. It is essential to remove the whole of the breast and not to leave behind any of the outlying portion. In thin women the operation is comparatively easy, but in stout women it is difficult, and there may be a good deal of bleeding. All hæmorrhage must be carefully arrested, and it is advisable to introduce a drainage tube for twenty-four or thirty-six hours, as there may be a considerable escape of serous fluid into the wound.

The advantages of this method of operating are that the nipple is left and the scar is not obvious. It often happens, however, that the skin becomes puckered and an unsightly folded area of skin remains after this operation, and in many cases, therefore—especially in stout people—it is preferable to remove the breast by an incision over its centre enclosing the nipple. The patient should always be asked before the operation is undertaken if she has any objection to the loss of the nipple.

MULTIPLE CYSTIC DISEASE.

Chronic lobular mastitis commonly ends in this condition. Sometimes limited inflammation of the lobule appears to lead to the formation of a fibro-adenoma. On examining a lobule which is the seat of mastitis the chief change in the early period is in the inter-acinous connective tissue, which undergoes marked proliferation. This may lead to atrophy of the epithelium, but proliferation of the epithelium of the acini not uncommonly takes place, and the latter becomes enlarged, and microscopic cysts are formed. The great majority of these remain quite small, but one or two may attain a considerable size.

TREATMENT.—The question of excision of the breast arises in these cases and, as we have said, some surgeons strongly advise complete removal of the organ. There is, however, no definite proof that cancer develops from this condition, and, unless severe pain or discomfort is present, the procedure seems to us to be too severe. Any cysts of considerable size may be tapped and injected (see p. 174) or any markedly affected or painful portion of the breast may be excised.

TUBERCULOSIS.

This condition is not uncommon, and a good many cases of chronic mastitis—especially those ending in suppuration—are really tuberculous in nature. The disease commences around the acini and may form a patch of chronic mastitis of considerable size; in other cases several

hard masses may be felt throughout the breast. The glands in the axilla may become enlarged.

The onset of the disease is often very insidious. One or more irregular swellings appear and increase fairly rapidly; they soften in the centre, and ultimately chronic abscesses and sinuses form. These sinuses have no tendency to heal, and the skin around becomes undermined in the manner characteristic of a tuberculous ulcer. The condition is serious because it may lead to destruction of the breast, and if the patient has a child, the milk may convey the tubercle bacilli to the infant. Before the formation of sinuses has occurred, it is not always easy to diagnose a tuberculous mass from scirrhus or from a patch of simple mastitis. It is therefore advisable in these cases to have a rapid section of the mass made at the time of the operation before proceeding to amputate the breast.

TREATMENT.—If the condition occurs during the child-bearing period, the best plan is to excise the entire breast when it is widely affected, as it must always be a source of danger to the children, and anything short of excision at this period of life rarely suffices to effect a cure. In older patients and when the disease is limited to a comparatively small area of the gland, it may be justifiable either to excise that segment of the organ or, if the patient objects strongly to such a procedure, to open up the sinuses thoroughly, scrape them freely and pack them with gauze for a time.

SYPHILIS.

Syphilis may be met with in the breast in all stages of the disease. A *chancre* on the nipple is not uncommon as the result of nursing a syphilitic child. It is a point of interest that, with rare exceptions, a syphilitic infant does not infect its own mother, although the latter may never at any time have displayed signs of syphilis, whilst a healthy wet-nurse will at once become infected. Chancres of the nipple are usually readily recognised by the size of the sore and the induration of the base, together with the early enlargement of the axillary glands.

Condylomata are not uncommon on the breast in secondary syphilis and occur either about the nipple or the areola or, when the breast is very pendulous, in the fold of skin below it. *Gummata* have also been found in the tertiary stage, but they are rare.

TREATMENT.—The treatment of syphilis in the breast is similar to that for the disease elsewhere (see Vol. I. Chap. XI.).

CHAPTER XV.

TUMOURS OF THE BREAST.

MAMMARY tumours may be either simple or malignant ; with the exception of the fibro-adenomata, the former are rare. Fibrous masses may occur, but they are most often the result of previous chronic lobular mastitis which leads to the destruction of the acini, and leaves a thickening which goes on increasing in size.

FIBRO-ADENOMA.

This is the most common benign tumour of the breast. Pure adenomata—that is to say, tumours composed entirely of acini—are rare ; in the great majority of so-called adenomata, the epithelial tubules are separated by a considerable amount of fibrous tissue, and the epithelial proliferation is probably secondary. In one form of fibro-adenoma the epithelial elements are chiefly arranged as small clusters of acini—the so-called ‘acinous adenoma’ ; whilst in the other, ducts ramify through the fibrous tissue and are dilated and ramified—the so-called ‘tubular or canalicular adenoma.’ The fibrous tissue forming the bulk of the tumour may be embryonic, or at any rate highly cellular ; in some cases it is myxomatous and the growth is then termed a ‘myxo-adenoma.’ Occasionally, the acini become dilated and form cysts, from the walls of which masses of young fibrous tissue covered with epithelium project into the cavity, forming ‘intra-cystic growths.’ Tumours in which intra-cystic growths are present sometimes grow rapidly and may attain a considerable size. Hæmorrhage not infrequently occurs into the cyst, and rapid increase in size takes place. Sometimes the connective tissue is of the embryonic type, and in these cases the growth of the tumour may be very rapid ; this variety has been termed ‘adeno-sarcoma,’ but it would seem probable that the true sarcomatous tumour of the breast is one which contains either no glandular elements whatever or only the remains of tubules.

These tumours are frequently encapsuled. They are generally single,

but they may be multiple, and they vary in size from a hazel-nut to an orange. When they are large they are often lobulated in outline from the presence of cysts. The axillary glands are not enlarged. Fibro-adenomata usually occur towards the periphery of the gland and form small, elastic tumours which are not tender. They often increase somewhat during the menstrual period, and the tumour remains stationary as a rule after reaching a certain size—and indeed in some cases may apparently disappear.

TREATMENT.—The only method of treatment is by removal, and it is well in all cases to recommend that this should be done not because

the tumour itself is dangerous, but because it may produce deformity if it increases in size, whilst its presence is always a source of anxiety to the patient; further, if seen in the early stage when there is no reliable history as to its rate of growth, a small sarcoma may easily be mistaken for a fibro-adenoma.

The operation is perfectly simple; a free incision is made over the growth until the capsule of the tumour is seen, and the tumour can then be readily removed. It is best to remove the capsule as well as the tumour, so as to be absolutely certain that no recurrence will take place, for a fresh tumour may



FIG. 44.—INCISION FOR REMOVAL OF ADENOMATA IN THE UPPER HALF OF THE BREAST. This incision leaves an almost imperceptible scar, and any area of the breast can be reached from it.

occur in the situation of the old one if it has been shelled out of its capsule. As a rule, the incision should be made in a line radiating from the nipple; but, if the tumour is situated in the upper part of the gland—in which situation it is important to avoid scarring—the growth may be removed by making a crescentic incision along the lower and outer border of the breast, pulling the latter upwards and forwards and enucleating the tumour from behind. When the growth is deeply embedded in the breast, it is well to insert a small drainage tube for a few days after the operation, otherwise blood is apt to collect in the cavity left after its removal and to give rise to a troublesome hæmatoma.

SARCOMA.

From 2 to 8 per cent. of breast tumours belong to the class of sarcomata; they are most usually of the round-celled or spindle-celled varieties. In the true sarcoma there is no growth of glandular tissue, but occasionally small portions may be found from accidental inclusion. The tumour possesses a spurious capsule and pushes aside and leads to atrophy of the surrounding breast tissue. A good many cases which are diagnosed as sarcomata turn out on examination to belong to the endotheliomata.

These growths generally occur in young women, and are seldom met with after the age of thirty. They form rounded tumours which grow rapidly, and may lead to ulceration of the skin over them, and they then fungate through the opening. In the early stages the affection is not easily distinguishable from fibro-adenoma, but the greater rapidity of growth, the rounded form of the tumour, and the tendency to fungate through the skin soon renders the diagnosis certain. In the round-celled variety especially, and in the endotheliomata, the axillary glands may become the seat of secondary deposits.

TREATMENT.—The treatment of sarcoma of the breast is early removal of the whole organ. Attempts to save any portion of the gland by removing the tumour and its capsule alone are very likely to be followed by recurrence. The pectoral fascia should be taken away in every case. Even if the tumour is small, the whole breast and the lower set of axillary glands should be excised. When the tumour is large, the operation should be done on the lines laid down for removal of carcinomata (see p. 181).

CYSTS.

Cystic disease of the breast and cysts in connection with fibro-adenomata have already been described.

SIMPLE CYSTS.

Occasionally, a cyst is met with in the breast without any tumour being found in connection with it and without any intra-cystic growth; this is the so-called 'simple serous cyst.' Cysts of this kind are supposed to arise after a localised mastitis which has led to active overgrowth of the epithelium and blocking of the ducts. These cysts generally occur in the substance of the breast and form rounded, tense tumours in which it is seldom easy to get fluctuation on account of the tension of the fluid. They are painless and generally single, but occasionally two or three large cysts may be present as well as a number of small ones. On moving the cysts, the nipple becomes pulled upon owing to the intimate connection of the cyst with the milk-ducts. Sometimes, though very rarely, there may be a little clear discharge from the nipple.

TREATMENT.—Isolated cysts can generally be readily cured by withdrawing the fluid and injecting a few drops of undiluted carbolic acid into the sac. As a result, the cyst wall becomes inflamed and the cyst fills up, but the fluid becomes absorbed in a few days and a cure results. Any fresh cysts can be treated similarly as they arise, and thus an operation is avoided. If, however, the cyst forms part of a fibro-adenoma, or if a solid mass is left after removal of the fluid the quadrant of the breast containing the cyst should be excised and a rapid section made to ascertain if it is malignant. If it is not malignant this will suffice, and in some cases a radical cure will follow this procedure; unfortunately, however, it is not uncommon on cutting into the breast to find that smaller cysts are scattered throughout its substance, and if a radical cure is desired there is no alternative but to remove the rest of the breast. It is for this reason that we advise a trial of tapping and injection, as this procedure is painless and avoids an operation, whereas on the other hand the only true alternative may be complete removal of the breast; excision of the affected area of the breast often ends in disappointment. If malignant disease is found on making a section, the operation described on p. 181 must be performed.

GALACTOCELE.

By the term 'galactocèle' is understood a cyst containing milk which is more or less altered in character. The swelling occurs during lactation and is due to dilatation of one of the larger ducts as the result of partial obstruction to the passage of the milk. That the obstruction is only partial is proved by the fact that pressure on a galactocèle as a rule leads to a discharge of milk from the nipple and partial emptying of the sac. Sometimes these cysts follow injury and are then supposed to be due to rupture of the duct. They are innocent tumours, and fluctuation can generally be made out in them.

TREATMENT.—The best plan is to excise the galactocèle through an incision radiating from the nipple. It is sufficient to remove the cyst itself and a radical cure results. After the cyst has been removed, the adjacent parts of the breast should be brought together with catgut sutures and a drainage tube inserted for two or three days. If excision is objected to, tapping and injection with carbolic acid may be employed, but the contents are thick and difficult to remove and the result is not nearly so certain as in the ordinary simple serous cyst.

CARCINOMA.

There are two principal forms of cancer of the breast—namely, those in which the disease commences in connection with the acini—the ordinary

'acinous carcinomata'—and those in which it originates in the ducts—'duct carcinomata'; the latter are referred to separately (see p. 192).

The ordinary acinous carcinoma commences in a lobule of the breast, by proliferation of the epithelial cells in the acini. The cancer cells are larger than the normal epithelium and do not simply line the wall of the acini, but quickly push their way into the surrounding tissues, passing into the lymph spaces and lymphatic vessels at an early period and growing along them. In some cases also blood-vessels become involved, and the cancer-cells penetrate their walls and form thrombi in their interior; it is by the detachment of these thrombi that the dissemination of the disease to distant parts of the body takes place. The local spread of cancer of the breast along the lymph spaces and vessels is a very important point, because it gives the surgeon a definite indication as to the parts to be taken away in attempting to eradicate the disease. Since the researches of Heidenhain and Stiles have shown the true extent of the normal breast tissue and the mode of distribution of the disease, and since extensive and methodical operations have been carried out on the lines indicated by these pathological researches, recurrence after operation has greatly diminished in frequency, and in a large number of cases none has taken place—at any rate, for a long period of time.

Cancer of the breast varies much in malignancy. The most common form grows with moderate rapidity, generally running its course in two to three years. It is very hard and is commonly spoken of as '*scirrhus*,' and in it a large amount of fibrous tissue is formed between the alveolar spaces; this fibrous tissue contracts and presses on the alveoli and leads to atrophy of the epithelial cells. Hence the centre of these growths becomes almost entirely converted into a mass of fibrous tissue, whilst at the periphery or growing part, there are large alveolar spaces containing epithelial cells with only a comparatively small amount of connective tissue between them. Sometimes the tumour grows extremely slowly and atrophies almost as fast as it grows. These are the typical cases of '*atrophic cancer*,' and the patient may live for many years before the tumour ultimately kills her; some indeed have lived as long as twenty years after the cancer has been discovered. Sometimes the growth extends with great rapidity—'*encephaloid cancer*'—and the patient dies a few months after the first discovery of the tumour. Every intermediate degree of malignancy is met with between these extremes. In some cases the cancer-cells, or the tissues around, undergo marked colloid degeneration—'*colloid cancer*'—and this is most commonly met with in young women; this form of the disease is generally less malignant than the ordinary one.

The tumour is single at first, and it is only at a later period that multiple growths are met with in the breast. From quite an early period, however, the lymphatic vessels in and leading from the breast are found to contain cancer-cells, and in a short time the nearest axillary lymphatic

glands become infected; it is said that this takes place within six months from the commencement of the growth in the breast. As the disease progresses, the infection spreads along the axillary glands into those in the posterior triangle of the neck and thence down into the mediastinum; it also spreads along the lymphatic vessels over the lower part of the thorax and so into the liver. As the cancer-cells spread towards the axillary glands, they are apt to be arrested in the lymphatics, and this is a very important point to remember because it explains why it is not sufficient to remove the breast and the axillary glands; the lymphatic channels between the two must also be removed. The cells may be carried along the anterior lymphatic vessels which run towards the exit of the branches of the internal mammary artery and thus pass directly into the thorax and into the sternum itself. They may also pass through the intercostal spaces and infect the pleura directly.

Cancer-cells may be carried to distant parts by the blood-stream, and secondary tumours may arise in regions with which there is no direct lymphatic connection. It has been estimated that, after a cancer has lasted in the breast for about two years, there will be metastatic deposits in other parts of the body, but much depends upon the malignancy of the particular form of the disease, and probably dissemination takes place much earlier than this in most cases.

Symptoms.—A tumour is present in the breast, generally towards the centre, but sometimes near the periphery; it is seldom larger than a hen's egg—and generally a good deal smaller—of stony hardness and ill-defined outline. In the atrophic form, however, it may be very difficult to find a distinct hard lump, the breast tissue being drawn in from all directions and masking the small growth. In this case the diagnosis must be made by the puckering of the skin, which is generally visible, and by the pursing up of the breast tissue. The skin over the tumour is freely movable in the earliest stages and there is no retraction of the nipple, but, as time goes on, the bands of fibrous tissue which connect the breast with the skin—the 'suspensory ligaments' of Astley Cooper—become involved in the growth and are pulled upon by the contraction of the fibrous tissue in the tumour, so that before long the latter does not move so freely, and on pushing it to one side, the skin tends to be drawn in or puckered, although it may not be actually infected. As contraction of the growth increases, the skin becomes permanently dimpled. If the tumour is situated near the centre of the gland, the lactiferous ducts also become involved and pulled upon, causing retraction of the nipple; this is as a rule greater on the side of the nipple on which the tumour is situated. Retraction of the nipple, however, must not be looked upon as a very important sign; should the tumour be situated at the periphery of the gland, it may not occur for a long time, if at all, whereas, if the tumour is growing very rapidly and very little contraction is taking place, no retraction of the nipple may be met with,

even though the tumour is actually situated in the centre of the breast. On the other hand, retraction of the nipple may be met with in chronic inflammatory conditions, more especially in tuberculosis, and also as a congenital malformation.

Once the 'suspensory ligaments' are involved, the cancer-cells are apt to spread in the lymphatic vessels running with them to the skin, and may thus enter the plexus of lymphatic vessels in the deeper part of the dermis and spread rapidly over a wide area. In that case the skin becomes red and oedematous, and this may be followed by a diffuse development of cancerous nodules in the skin which run together and produce a hard, brawny, red patch—the condition known as cancer 'en cuirasse'; this is usually met with in the more rapidly growing forms. In other cases the growth itself spreads to and involves the skin, which presently becomes ulcerated, and a typical cancerous ulcer is formed which after a time usually presents a deep crater-like appearance.

A striking evidence of the great contraction that occurs in cancerous tumours of the breast is that the organ may actually appear smaller than its fellow, although it may contain a tumour of considerable size. Indeed, in atrophic cancer the breast tissue may disappear almost entirely, being drawn into the growth and gradually destroyed. Even at a comparatively early period it will be found that the affected breast, whether smaller or not, is less pendulous than its fellow, and the nipple on the affected side is at a higher level than on the other.

Before long, the tumour becomes adherent to the pectoral fascia, and subsequently to the pectoralis major. Adhesion of the tumour to the pectoral fascia occurs early in some cases—at any rate, when the tumour is situated towards the deeper part of the breast—and is usually detected by instructing the patient to grasp one hand firmly in the other and try to separate the arms. This renders the pectoral muscle tense, and then by attempting to move the breast and tumour in the direction of the muscular fibres the presence or absence of adhesion may be ascertained. This question is of great importance because if the growth is adherent to the pectoral fascia it implies that the whole of that fascia must be looked upon as possibly infected, and it is still more important when the muscle itself is actually involved, because the arrangement of the lymphatics in the muscle is such that the disease may be quickly disseminated throughout it as the result of the natural movements.

The axillary glands become enlarged at a fairly early period of the disease, but it must be borne in mind that they are probably infected long before they can be felt. The glands first enlarged are usually those along the outer edge of the pectoral muscles; the infection extends from this point upwards along the axillary glands and thence into those at the root of the neck.

Cancer of the breast is often associated with a characteristic stabbing

pain from a very early period, and it is generally this pain that leads the patient to examine the breast and discover the tumour. In a considerable number of cases, however, there is no pain at all, and the tumour is only discovered accidentally. In the early stages the patient remains in good health, but after the disease has lasted for some time there is definite weakness and loss of flesh, and a pale, earthy, cachetic look makes its appearance; this does not, however, necessarily imply infection of internal organs and may disappear after a complete operation.

As a rule the cancer remains limited to the breast first involved, but a cancerous tumour may form in the opposite breast in a certain number of cases. It is probable that in such instances the cancer-cells have been carried across the middle line in the lymphatic vessels and that the tumour in the second breast is secondary to the original one and not an independent development. In such cases, the primary tumour is usually situated on the sternal side of the nipple. Sometimes the lymphatic vessels may carry the disease to the glands in the opposite axilla without the second breast becoming infected.

TREATMENT.—Carcinoma of the breast is a form of malignant disease in which the results of treatment are on the whole extremely satisfactory, more than half the unselected cases operated on by the methods described below remaining free from recurrence—at any rate, for several years. For this reason all suitable cases should be operated on as early and completely as possible, and it is also important that no swelling in the breast should be treated by palliative measures when there is the slightest doubt as to its innocence.

The cases unsuitable for complete extirpation are those in which there is extensive infection of the glands above the clavicle, or disease in internal organs, bad cases of cancer 'en cuirasse,' and cases in which the tumour has become adherent to the chest wall. In the absence of these local conditions, we advise extirpation provided that the general state of the patient permits it, even though the local disease be very extensive, and in a certain number of cases so treated, a long period has elapsed without recurrence, although the condition was apparently very unfavourable. Age does not form an important bar to the operation; we have operated on patients up to eighty years of age, who have done extremely well. Extreme feebleness or very advanced age, especially if the growth is a typical atrophic cancer, would however cause the surgeon to hesitate before operating. It is a very debatable point whether coexisting disease in both mammae contra-indicates operation. If it is very extensive on both sides, it is of course useless to expect a radical cure; but if the disease in the second breast is clearly secondary to that in the first, and is not far advanced, we should advise removal of both breasts. It would, however, be hardly possible to subject the patient to two operations of this magnitude on the same day; but the second operation—which should be on the less widely

affected breast—may be done after an interval of a week or ten days, and the operation performed on both sides should be the one described below.

By some authors atrophic cancer is looked upon as a form of the disease for which operation is undesirable. From this view, however, we would dissent. Not only is the operation desirable, but the results are extremely favourable, and, although a patient with atrophic scirrhus may not necessarily die for some years if unoperated upon, she is very apt to have much suffering in connection with the spread of the disease, and at any time the tumour may take on active growth. There seems no reason whatever why the patient should not be freed of the disease simply because it is slow-growing, and although formerly, when partial operations were performed, rapid recurrence often took place, we have never had any such experience in these cases when a suitable extensive operation has been performed.

Radical treatment.—However small the tumour may be, the operation in all cases should aim at removing the entire breast and its corresponding lymphatic area as high as the apex of the axilla. The latter step is necessary because the disease extends into the lymphatic system at a very early period and is carried to the neighbouring lymphatic glands; from these it soon passes on to succeeding groups. Thus it affects first the lower group of glands in the axilla, then the upper, then the glands in the posterior triangle, from which it extends to those at the root of the neck and in the mediastinum. If there is marked infection of the glands at the apex of the axilla, the root of the neck should also be opened up and the glands removed, but in a considerable number of cases this is not necessary.

The lymphatic distribution in connection with the breast, according to Sappey, commences in the form of small plexuses around the acini whence vessels run along the ducts, joining with others from the adjacent acini and forming plexuses around the ducts. These plexuses increase in size until they reach the nipple, and thus lymph from all parts of the gland is carried to the nipple in the first instance. Here they form a plexus beneath the areola (the 'sub-areolar plexus' of Sappey) and from this three or four large lymphatic trunks carry the lymph from the breast and the skin in its vicinity to the axillary glands. These lymphatic vessels run in the fat between the breast and the axilla in the neighbourhood of the lower border of the pectoralis minor.

Since the publication of Sappey's description, it has been found by pathological and clinical investigation that there are other paths by which the lymph may be conveyed from the breast. Thus, lymphatics run from the plexuses around the lobules of the breast along the suspensory ligaments of Astley Cooper to join the plexuses in the deeper parts of the skin, and plugs of cancer-cells have been found in the vessels in these ligaments. Another very important distribution is by vessels

which leave the deeper surface of the breast and join lymphatic plexuses in the pectoral fascia, running thence to the axillary glands. This seems to be one of the commonest paths by which infection spreads in cancer

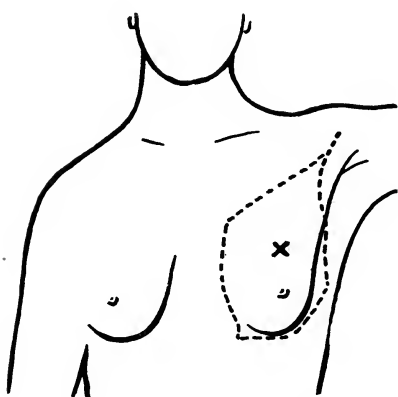


FIG. 45. — INCISION FOR REMOVAL OF A CANCEROUS TUMOUR OCCUPYING THE UPPER QUADRANT OF THE BREAST.

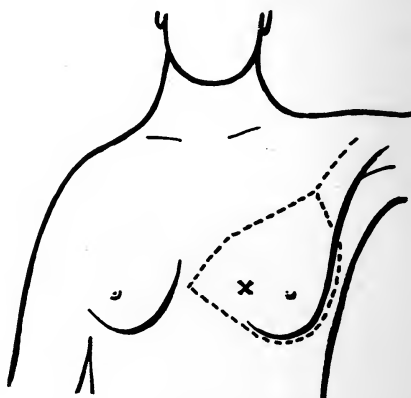


FIG. 46. — INCISION FOR REMOVAL OF A CANCEROUS TUMOUR OCCUPYING THE INNER QUADRANT OF THE BREAST.

of the breast. The lymphatics in the pectoral fascia also communicate with those in the greater pectoral muscle and thus the disease may be distributed throughout that structure. It is further probable that lymphatics pass into the mediastinum along the perforating arteries at the inner aspect

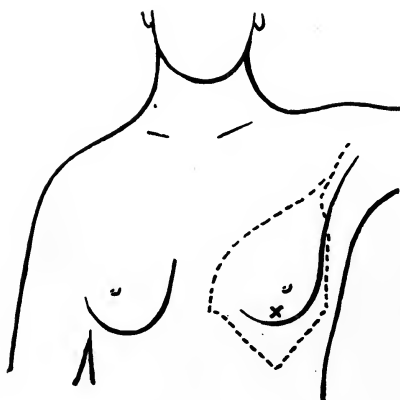


FIG. 47. — INCISION FOR REMOVAL OF A CANCEROUS TUMOUR OCCUPYING THE LOWER QUADRANT OF THE BREAST.

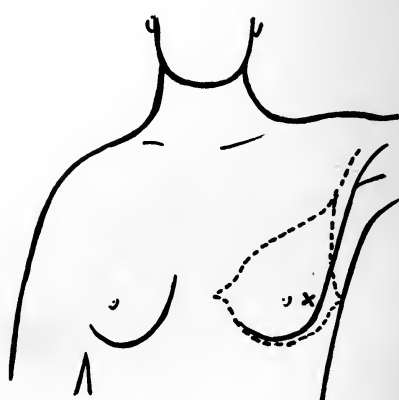


FIG. 48. — INCISION FOR REMOVAL OF A CANCEROUS TUMOUR OCCUPYING THE OUTER QUADRANT OF THE BREAST.

of the mamma, and there is also reason to believe that a lymphatic communication exists with the opposite side across the front of the sternum. Sampson Handley has pointed out that the disease may also spread downwards in the fascia over the costal attachment of the abdominal

muscles, and ascribes the frequent occurrence of secondary nodules in the liver to infection by this route.

In the axilla the chief lymphatic chain runs upwards along the lower aspect of and in close connection with the axillary vein and behind the costo-coracoid membrane, where the vein passes into the neck, and, if infection spreads past this point, enlargement of the glands in the neck appears behind the lower end of the sterno-mastoid. The infection may also spread up in front of the vessels and nerves into the posterior triangle about the centre of the clavicle, and a chain of enlarged glands may also be found extending upwards behind the axillary vessels along the course of the nerve of Bell, communicating eventually with glands in the back part of the posterior triangle of the neck.

In performing the operation the patient lies on her back, with the arm on the affected side at right angles to the body, the hand being fastened by a bandage to the head of the table; the arm should not be higher than a right angle, otherwise the head of the humerus may press unduly on the axillary plexus and lead to temporary paralysis.

The exact details of the operation will of course vary with the individual case, but there are certain general principles which underlie all operations for cancer of the breast. The first point to be considered is the *removal of the skin*. In carcinoma of the breast the skin is often widely infected with the disease, and this is especially likely to be the case where the skin is tacked down or actually adherent to the growth. It is therefore always necessary to remove a large amount of skin in the neighbourhood of the tumour, and inasmuch as the lymphatics of the breast converge towards the nipple, and there is always therefore the possibility of infection of the wide-meshed sub-areolar plexus, the skin over the whole prominent part of the breast must be taken away. If the growth is centrally situated, removal of the skin over the whole breast will in most cases also remove a wide area around the tumour, but if the growth is situated towards the periphery of the breast, a wider area of skin must be taken away. The extent to which the skin is affected must be estimated by observing the points at which puckering occurs when the tumour is moved under the skin, and a zone is then marked out by a series of short incisions around the tumour, leaving a margin of at least two inches of apparently normal skin on every side of the obviously adherent portion. The skin which

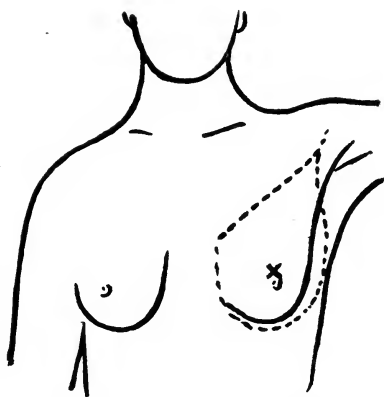


FIG. 49.—INCISION FOR REMOVAL OF A CANCEROUS TUMOUR OCCUPYING THE CENTRE OF THE BREAST.

is to be taken away is then surrounded by a continuous incision joining up the small cuts which have been already made, and at the upper and outer part the incision is prolonged outwards over the attachment of the pectoralis major, care being taken to keep this incision above the axilla. If the outer end of the incision is too low, there is a tendency to the formation of a web-like scar across the axilla, which limits the movements of the arm. This method of making the incision leads to the formation of a somewhat irregular wound, but it is preferable to the ordinary routine incisions, in that it does not unduly sacrifice healthy

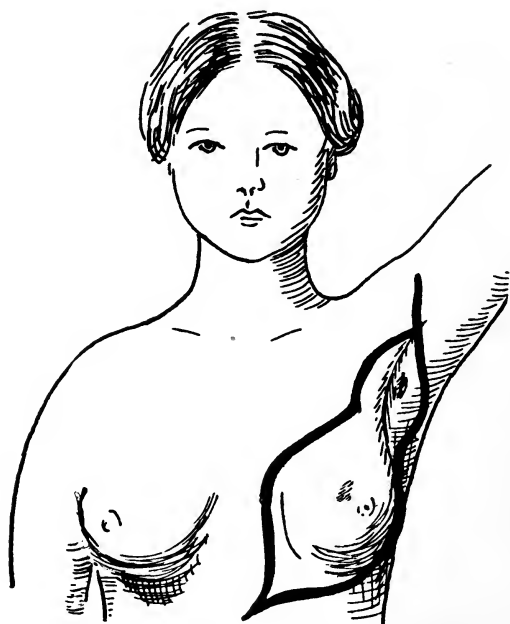


FIG. 50.—INCISIONS FOR REMOVAL OF THE BREAST AND CONTENTS OF THE AXILLA WHEN THE GLANDS ARE MUCH ENLARGED.

tissues, while it provides for thorough removal of the disease. If the skin over the axillary glands is bound down to them, it must be treated like the skin over the primary growth and removed widely.

The importance of removing a wide extent of skin cannot be insisted upon too strongly, and the surgeon should never perform this part of the operation unsatisfactorily, from the fear that it may be impossible to bring the skin together afterwards. It will usually be possible to close the wound completely by means of tension stitches and undercutting, or by a plastic operation, but even if not, the wound can be made to heal by skin-grafting. The disadvantages of a slowly healing wound must never be allowed to weigh against the advantages of thorough removal of the disease.

It has been shown by Stiles that the prominence of the breasts does not correspond accurately to the limits of the gland, which may extend in the form of outlying lobules as far upwards as the clavicle, as far inwards as the sternum, as far outwards as the axilla, and as far downwards as almost to reach the costal margin. In a radical operation it is important to excise the subcutaneous tissue in such a way as to remove all these outlying lobules. After making the incision, therefore,



FIG. 51.—AMPUTATION OF THE BREAST FOR CARCINOMA. *Marking out the skin incisions.* The skin remaining is freely undercut so as to remove as much of the subcutaneous fat as possible.

the skin is first raised with only enough of the superficial fascia to ensure its nutrition, and the incision is gradually deepened by undercutting the skin until it reaches the sternum on the inner side, the clavicle above, the fibres of the latissimus dorsi on the outer side, and the upper part of the rectus abdominis below. When the edge of the latissimus dorsi has been exposed, it is well to detach the flap backwards from the posterior surface of that muscle for three or four inches so that it can be pulled forward when the wound is closed (see Fig. 52).

After the flaps have been dissected up to the extent described, the next point is to detach the costo-sternal attachment of the pectoralis major. For this purpose the skin at the upper part of the wound is retracted and the fat that has been left over the clavicular fibres of the pectoralis major is dissected downwards from the muscle, until the sternal attachment is reached. The muscle is then split with the handle of the knife, in the direction of its fibres, at the junction of these two component parts, and the surgeon slips his hand into the cleft thus formed and lifts up



FIG. 52.—AMPUTATION OF THE BREAST FOR CARCINOMA. *Cutting the posterior flap.*
This is dissected back so as to expose the latissimus dorsi muscle.

the costo-sternal portion of the muscle, putting its fibres on the stretch; the inner margin of the incision is retracted and the sternal attachment of the muscle divided close to the bone, from above downwards. As each fasciculus of the muscle is divided, the anterior branches of the internal mammary artery come into view, and it is usually possible to clamp these before they are cut, thus avoiding a great deal of hæmorrhage. When this part of the pectoralis major has been divided, the incision is carried downwards over the upper part of the rectus and the external oblique muscles, and the fascia covering the upper part of these muscles is dissected up and left attached to the breast. The pectoralis

major, with the breast lying over it, should then be raised from the chest along with the underlying fascia, thus exposing the external intercostal muscles and the anterior surface of the pectoralis minor. In doing this the attachment of the pectoralis major to the lower ribs will be divided, and at the upper part several large branches of the thoracic axis and of the external anterior thoracic nerve will be seen; the

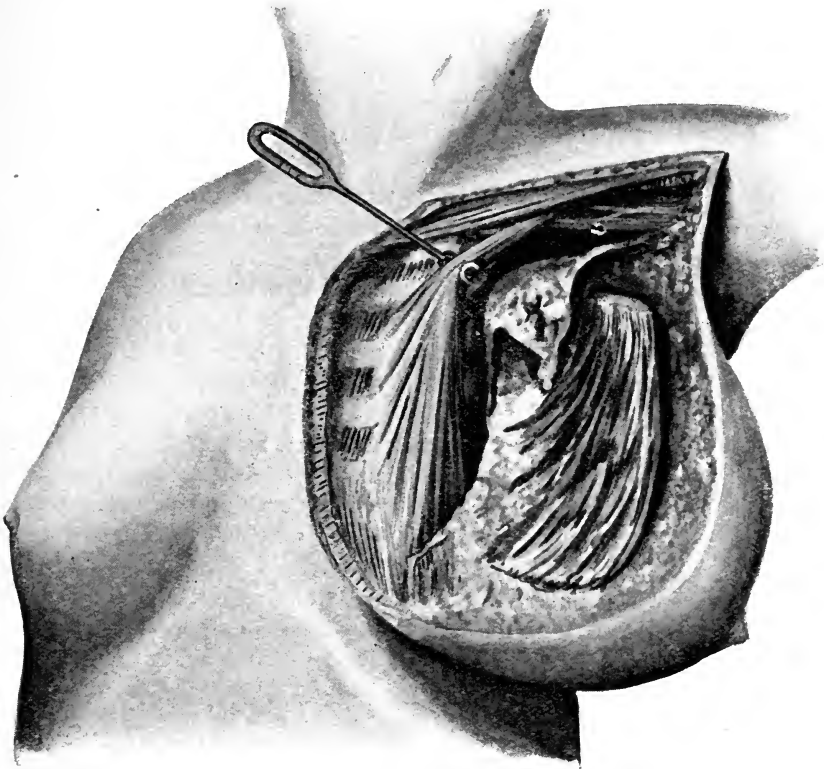


FIG. 53.—AMPUTATION OF THE BREAST FOR CARCINOMA. *Clearing the axilla.* The insertion of the pectoralis major has been divided and the muscle cut away from the thoracic wall. The pectoralis minor has been hooked up and the fat, fascia, and glands have been dissected down from the apex of the axilla.

nerves should be cut short and the vessels clamped before they are divided.

The elbow should now be raised and brought a little forward so as to relax the tissues, and the clavicular portion of the pectoralis major is drawn upwards and away from the chest so as to expose the space beneath it; the fat and fascia should be carefully dissected away from the under surface of the muscle, care being taken to preserve its nerve supply. The fascia is next divided along the inner border of the pectoralis minor, thus exposing the outer edge of the costo-coracoid

membrane, and by picking up the edge of this fascia, it is now possible to detach the inner part of the membrane from the first intercostal space and the upper part from the subclavius muscle. This part of the operation should be done mainly by blunt dissection, using the knife as sparingly as possible so as to avoid wounding the vein. For this purpose the ordinary blunt dissector or the special dissecting combs designed by Kelly may be used. The sheet of fascia is now turned outwards, and the first part of the axillary vein is exposed; this should be cleaned and all the fat and fascia around it turned downwards. It is imperative that this stage of the operation should be done thoroughly. Special care should be taken to remove all the fat behind the upper part of the axillary vein, as infected glands are often present in that situation.

The next step in the operation is to detach the humeral attachment of the pectoralis major. This should be done quite close to the bone, otherwise a stump of muscle is left, which becomes adherent to the scar and limits the movements of the arm. The fascia over the biceps and coraco-brachialis is then incised and turned downwards so as to expose the third part of the axillary vein and the brachial plexus, all the fat and fascia in this region being cleaned off and turned downwards towards the axilla.

The fascia is now detached from the outer border of the pectoralis minor, and the deep surface of that muscle is separated from the underlying fascia, care being taken to preserve its nerve and vascular supply, and the muscle is then retracted upwards and away from the chest wall. By following up the fascia over the front of the vein, the point is reached at which the vein was cleared from above, and the fat and fascia from the region of the costo-coracoid membrane can be drawn downwards and outwards towards the axilla. The freeing of the vein and the other axillary structures is then resumed from the point reached before the attachment of the pectoralis muscle to the humerus was divided, branches of the axillary artery and vein being clamped and divided as they are cleared and the fascia being followed up in front of the vessels along the inner side of the coracoid process and turned down with the rest. In this way the fat and glands are gradually cleared from the vessels and turned down until the lower part of the axilla is reached.

The dissection of the breast and fascia from the chest wall is now resumed, and the fascia over the serratus magnus is detached until the position of the nerve of Bell is nearly reached. This nerve is identified and cleared, and its point of attachment to the muscle is noted. The nerve of Bell is followed up into the root of the neck, and the mass of fat and glands which run up behind the vessels and nerves, and lie over the nerve of Bell, is peeled down; in doing so the intercosto-humeral nerve should be preserved, for the time at any rate. At this stage it is well to cover up the wound with hot cloths, ligature all the

vessels which have been clamped, and pick up and tie any other bleeding points.

All the fat and glands will now have been cleared from around the upper part of the axillary vessels and nerves, and turned down so that they lie in the hollow of the scapula along with the fat and glands situated in that region which has not yet been disturbed. The rest of the wound is covered up with hot cloths, and the removal of this mass along with the breast is proceeded with. The sheath of the axillary vein is defined and opened, and the fascia and fat are turned down from it with a blunt dissector until the subscapularis muscle is seen behind it.

In doing so, branches of the axillary vein will be encountered, and should be clamped and divided; and if the nerve of Wrisberg comes into view, as it generally does, it should be carefully preserved. The fascia is peeled down from the surface of the subscapularis, care being taken to preserve the subscapular vessels and nerves. At this stage the question will arise whether the intercostohumeral nerve can be preserved or not. If there are many enlarged glands in the fat it is better not to make the attempt, as diseased lymphatic vessels may be torn across and infect the wound; in that case the nerve should be divided close to the thorax. If, how-

ever, this is not the case, it is a great addition to the comfort of the patient to leave the branches going to the arm. The operation is completed by detaching the rest of the fat lying in the hollow of the scapula, taking special care to clean the long subscapular nerve and vessels, especially at their attachment to the latissimus dorsi. The breast and the pectoralis major muscle, with all the glands and lymphatic vessels included in the various fascial extensions, can now be detached with a few touches of the knife.

If the operation is done systematically, the larger blood-vessels will have been seen and secured before they are divided, and the loss of blood will have been comparatively slight; but the wound must be carefully inspected before it is closed, as there are often a number of small points which require ligature.

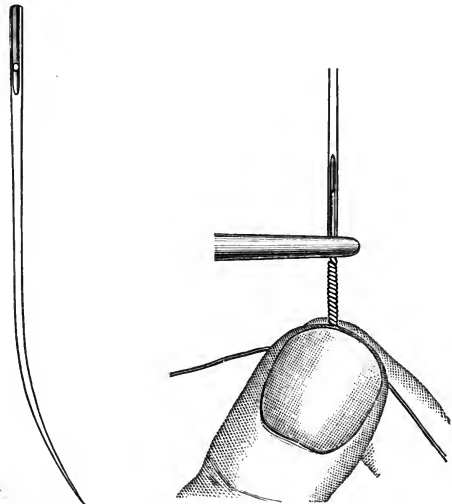


FIG. 54.—LISTER'S NEEDLE FOR THE INTRODUCTION OF SILVER WIRE, AND THE METHOD OF THREADING IT. The wire is clamped into the groove in the eye with pressure-forceps, and the two ends are evenly twisted up, one round the other.

After the bleeding has been satisfactorily dealt with, the wound should be closed. This is often a matter of some difficulty, and if a large amount of skin has been taken away, some form of relaxation suture is usually necessary. Silver wire (23 Birmingham wire gauge) is probably the best material to use, and should be threaded on a Lister's wire needle (see Fig. 54). The wire is flattened into the grooves in the needle and the ends are twisted together tightly so that they lie closely together, and are of the same thickness as the needle. The needle is passed through each flap at some distance from the edge of the wound, and the ends of the wire are grasped with forceps and tightened up until sufficient approximation of the edges of the wound has been obtained; the wire is kept taut while the ends are bent over each other so as to form a loop and cut off. Several of these sutures are usually required, and it may be necessary to insert some of them temporarily so as to see how the wound will come together in one direction, removing them if it is found that another direction is better; sometimes it may be found difficult to suture the wound as a line, and it may be better to bring the edges together so as to form a tri-radiate scar. When these sutures have been inserted, the edges of the wound are united with a continuous suture of silk or silkworm-gut. Where the parts are very tight, button sutures are of great service (see Vol. I. p. 140).

With a little ingenuity and further undermining of the skin it is usually possible to get the edges of the wound together, but in cases in which a large amount of skin has been taken away, especially if the patient is thin, this may not be possible without undue tension. In that case it is well to perform a plastic operation if the condition of the patient permits, turning in flaps preferably from the lower part. The exact form of these flaps will depend on circumstances, but generally they can be obtained from the abdomen. In any case, it is well to close the axillary part of the wound so as to avoid interference with the movements of the arm. It is also of importance to cover in any portion of costal cartilage which has been denuded in the course of the operation, as this form of tissue granulates very slowly, and the wound may remain open a very long time if a piece of cartilage is left exposed at the bottom of it. If, however, only a small area of the thorax cannot be covered, that can be left and skin grafted as soon as it is granulating. It is well to insert a drainage tube in all cases, and this is best done through a separate incision in the skin towards the outer and posterior part of the wound.

At the conclusion of the operation, a large dressing should be applied, which should extend well round to the back of the patient and also well below the drainage-tube opening. This may be fastened on with a many-tailed bandage provided with shoulder straps. The arm should be kept at right angles to the body, and supported on a pillow, and may be either rotated upwards, with the hand fastened to the head of the bed, or

downwards and supported on a pillow. The patient frequently likes the position of the hand to be changed occasionally.

It is very rare that a carcinoma of the breast can be satisfactorily treated by a less drastic operation than the one we have just described. Some surgeons leave the pectoralis major, removing merely the fascia over it with a thin layer of muscle. This, however, renders the clearing out of the apex of the axilla more difficult and the removal of the costo-coracoid membrane impossible.

Some surgeons also recommend the removal of the pectoralis minor muscle in all cases; but this is often unnecessary as it can be readily pulled out of the way so as to allow the parts behind it to be thoroughly cleared. If, however, there is marked glandular infection in that part of the axilla, it is well to take it away, after the fat and glands have been peeled down from the upper part of the axilla and the costo-coracoid membrane removed. The fibres of origin of the muscle from the ribs are first detached and then it is divided above at its insertion into the coracoid process.

Another point to be considered is the advisability of clearing out the posterior triangle of the neck when the breast has been removed. Probably increasing experience will lead surgeons to do this more often than they do now. If there is any enlargement of the glands in this region it is better to clear out the space at the first operation, for, although this prolongs the operation somewhat, it is not possible at a second operation to remove the lymphatic vessels between the neck and the axilla with the same ease and certainty. If the infection of this region is extensive the question of the operability of the case will have to be considered, for, as in carcinoma elsewhere, an incomplete operation frequently does more harm than good. It is in the cases in which there is no visible infection of the glands that the surgeon must decide this matter, and the conclusion to which we have come is that when there is distinct enlargement of the glands at the upper part of the axilla, it is well to open up the posterior triangle of the neck and to clear out all the fat and glands behind and beneath the sterno-mastoid muscle. This is best done by a separate incision just above and parallel to the clavicle.

After-treatment.—There may be a considerable amount of oozing of blood and serum in the first few hours after the operation, which may come through the dressing, but provided that this contains a reserve of antiseptic, e.g. cyanide gauze, there is no need to disturb the patient by changing the dressing until next day. If, however, blood comes through, the bandage and wool should be soaked with 1 in 20 carbolic lotion and fresh gauze and wool applied outside. For the next two or three days the wound should be dressed daily, and if at the end of the third or fourth day it is found that only a little blood-stained serum is coming away the tube can be left out. If the wound is aseptic no further drainage is necessary; the practice of pushing strips of gauze into the

drainage-tube opening after the tube has been removed is especially to be condemned. The stitches of relaxation are removed in about a week, but the continuous skin suture may be left a few days longer, as there is generally a good deal of tension on it. It is a mistake to remove the stitches simply because they are cutting through the skin, and their premature removal may lead to extensive separation of the edges of the wound. Slight necrosis may occur at the point of insertion of the deep stitches, but this is not of any moment provided that the principles of wound treatment laid down in Vol. I. are rigidly adhered to.

While the wound is healing, the arm must be kept at right angles to the thorax, and even when the patient is allowed to leave her bed it should be supported in this position by pillows and cushions. If this is not done, the arm is apt to become bound to the side by the cicatrix. When healing is complete the patient should be encouraged to use the arm so as to prevent stiffness and to regain muscular power.

The complete removal of the lymphatic vessels from the axilla may lead to swelling of the arm, which must not be confounded with that produced by blockage of these vessels by extensive malignant disease. This swelling usually comes on a few weeks after the operation as the deeper part of the cicatrix becomes dense. At first the swelling is due to a fluid œdema which can be massaged away, but later on there is frequently a certain amount of true hyperplasia. The swelling can be kept under control to a certain extent by massage and elastic bandages, but a permanent enlargement of the arm will often remain, which does not, however, materially affect the utility of the limb. For this condition, Sampson Handley's operation of lymphangioplasty may be employed (see Vol. II. p. 33). Although the permanent value of this plan seems doubtful, it is worth a trial in the early stage of a swollen arm after these operations; when, however, the condition has lasted for some time and true hyperplasia has taken place, the result is not likely to be satisfactory.

For a good many years, we have advised repeated courses of X-ray treatment over the part operated on, the first course beginning about six weeks after the operation, the applications being made about every third day for three weeks; four courses a year are given for the first two years. It is very difficult to decide what value is to be attached to this plan, because we very seldom have local recurrences after the operation described above, even when X-rays are not employed, but we have had several advanced cases in which recurrences seemed very likely to take place, in which these X-ray courses have been employed and in which there has been no recurrence. It seems probable that small groups of cancer-cells which may have been left behind might be destroyed by the application of X-rays soon after a complete operation, and therefore it seems a reasonable precaution to take.

Of late, the suggestion has been made that a tube of radium should

be left in the wound at the time of the operation and taken out after twenty-four hours, but the difficulty is to know at what part of the wound to insert it. In several cases, however, in which we have opened up the posterior triangle of the neck, we have done this, but whether with advantage or not we cannot say. If the surgeon feels that the disease has not been satisfactorily removed, it is a proper thing to do, but when a wide margin of healthy tissue has been taken away it seems to be superfluous.

After an operation for cancer of the breast, the patient should be advised to report herself to the surgeon at intervals of three months for at least three years, in order that any recurrence may be promptly recognised and treated. The situations which should be specially watched are the posterior triangle of the neck, the area of the operation, the lungs, and the liver. It is important to remember the presence of the omo-hyoid muscle in the posterior triangle, as this structure is apt to become unduly palpable when the fat of the posterior triangle has been removed, and may resemble a recurrent gland. Careful examination will usually make the diagnosis clear, but in any case in which there is any doubt on the matter, it is better to operate and not to wait for the course of events to clear up the diagnosis.

In our experience local recurrence is quite rare after the operation described above, and usually if it does take place a second operation is hardly possible. If the recurrent growth is extensively adherent to the ribs it is better to leave it alone, but if only one rib is affected, it is sometimes possible to excise the nodule with the piece of rib involved. This is more easily done when the recurrence is near the sternum, because the pleura is separated from the ribs by the *triangularis sterni* in this situation.

Palliative treatment.—When the case is obviously unsuited for complete removal, the question arises whether anything can be done to relieve the patient, and one important point is whether the breast should be removed even though there is no hope of eradicating the disease. Rapidly growing cancers of the breast left to themselves usually cause intense pain and trouble from the local spread of the disease in the breast and axilla, and if the disease can be taken away completely from this region, the patient will be saved much pain and discomfort, and death from the disease elsewhere may be much easier. In cases of rapidly growing disease, therefore—especially in young women—it may be right to remove the breast and axillary glands freely, even though there may be disease elsewhere. It is questionable, however, whether this is worth while if the skin is actually affected; in any case, very free removal of the skin should be adopted.

Oöphorectomy.—Much has been written concerning the value of oöphorectomy for inoperable cancer, and, according to the published cases, the immediate effect of the operation has been striking in some cases, the

tumour diminishing in size, and in parts entirely disappearing, whilst the patient has improved in health and the local disease has remained quiescent. In our experience, however, a time comes—from six months onwards—when the effect of the operation seems to pass off and recrudescence of the disease occurs, and we know of no instance in which the patient can truly be said to have been cured by the operation. The best results that we have seen have been in cases in which the local disease has been eradicated as freely as possible simultaneously with the oöphorectomy; but even here we have seen striking instances of the futility of the procedure.

Thyroid extract.—Sir George Beatson, who first introduced oöphorectomy, advocated the long-continued administration of thyroid extract in increasing doses in combination with the operation. Other observers have claimed improvement from the use of thyroid extract alone. We cannot, however, say that we have ever seen any advantage in using this drug which seems to us to have value only as a placebo, the patient being happier while she is taking it and being under the impression that good may result.

In the case of recurrences, X-rays and radium are sometimes of value, especially when the recurrence is superficial. We have seen a few good results in such cases, but when the growth has been at all deeply seated these methods do not seem to be of any material value. In limited deep-seated recurrences the best plan is to cut down on the swelling and apply the radium in immediate contact with it. In inoperable cases also the free application of radium externally seems to be of value in some instances, the growth of the tumour being at any rate retarded and sometimes apparently checked for a time.

PAGET'S DISEASE OF THE NIPPLE.

A peculiar ulcerative disease of the nipple was first described by Sir James Paget, and is commonly spoken of as Paget's eczema. This condition affects the nipple and extends to the areola, the affected surface becoming raw, finely granular, and discharging a copious, clear, yellowish viscid fluid. This condition is not a true eczema, but is in reality a cancerous change in the papillary layers of the skin. In some cases it is associated with cancer of the breast, and so constant is the association between the two conditions that most surgeons advise complete removal of the breast in cases of Paget's disease, even though no tumour can be discovered in it.

TREATMENT.—In any case the affected nipple and a considerable area of the structures around should be freely removed, and it seems much safer from clinical experience to remove the breast and the glands as well. This should be done thoroughly, but, unless an actual tumour be felt

in the breast, it is unnecessary to remove more than the lower mass of glands from the axilla, and the dissection need not extend upwards above the pectoralis minor.

DUCT PAPILLOMA AND DUCT CARCINOMA.

Papillomata may form small tumours projecting into the galactophorous ducts and blocking them so as to give rise to dilatation behind. They bleed readily, and one of their symptoms is the escape of a clear or bloody discharge from the nipple. On examining the breast in the early stages nothing may be discovered, but a small tumour may generally be felt later on beneath the nipple or areola. It is quite impossible to diagnose a duct papilloma from a duct carcinoma in the early stages, although the latter may be suspected when the discharge always contains blood; later on, the carcinoma forms a larger tumour and follows a course similar to that of the ordinary form of cancer, though it is apparently less malignant.

TREATMENT.—In all cases the part of the duct involved should be excised if it can be localised, and if examination of the specimen removed shows it to be simply a pedunculated papilloma projecting into the duct, the surgeon may be content with the local removal; should there be any evidence that the epithelial elements are infiltrating the tissues around, however, the case will be one of duct carcinoma, and the surgeon should at once proceed to remove the breast completely. A rapid section, cut and stained at the time of the operation, is of great value in deciding this point. If the case is seen at an early stage, an exception may possibly be made to the ordinary rule of removing the axillary glands at the same time, but if the disease has extended beyond the wall of the duct or if there is any sign of enlargement of the glands in the axilla, the complete operation for cancer of the breast should be undertaken (see p. 181).

SECTION II.—AFFECTIONS OF THE THORAX AND ITS CONTENTS.

CHAPTER XVI.

FRACTURES OF THE RIBS, COSTAL CARTILAGES, AND STERNUM.

FRACTURE OF THE RIBS.

THESE injuries are most common during adult life ; when growth is complete, the ribs become less elastic and the cartilages more ossified and brittle, and fracture is therefore more likely to follow comparatively slight violence than in the young in whom the ribs are more elastic and may bend without breaking. Fractures of the ribs are more common in men than in women, and may be due to either direct or indirect violence. The seat of a fracture from *direct* violence corresponds to the point of application of the force, and the ends of the bones are driven inwards and the inner surface of the rib is more split up than the outer. Unless the violence is severe or the rib is fractured in more than one place, the elasticity of the bone causes it to resume its normal outline almost immediately ; but before this occurs, the sharp edges may have lacerated the intercostal vessels or punctured the pleura or the lung when they were driven in. The commonest cause of fracture of the ribs is, however, *indirect* violence causing compression of the chest from before backwards or from side to side. Under such circumstances the ribs are bent beyond their limit of elasticity, and give way at the point of greatest stress. In antero-posterior compression, which is the commonest form of injury, the fracture occurs either about the mid-axillary line or at some point between that and the angle of the ribs. In this form of fracture the broken ends of the bone bend outwards, and the deeper structures are rarely injured except when the thorax

is subjected to a crushing force. Fracture of the ribs may also occur from *muscular action* alone—for example, during parturition.

The ribs most frequently fractured are the middle six; the first three are protected by the clavicle and the thick layers of muscle over them, whilst the last three are so mobile that they readily yield before the pressure. Occasionally, the rib is incompletely fractured, the outer surface alone being broken through; this is generally a result of indirect violence, and in such cases there is practically no displacement, the fractured ends being held together either by the periosteum or by a few osseous fibres on the inner surface of the bone. When only one rib is fractured, the displacement is slight, unless the bone is broken in more than one place; in the latter case one fragment may lie inside the other.

The *symptoms* are severe stabbing pain on breathing or coughing, and extreme tenderness on pressure; in many cases no crepitus can be made out nor can any displacement be found. When crepitus cannot be felt, a fracture may be suspected if pain occurs on compressing the chest from before backwards; if a fracture is present, sharp pain will be felt at the spot at which the bone is broken. Crepitus is often obtained by placing the hand flat upon the suspected area and making the patient breathe deeply or cough. It is never advisable, however, to make serious attempts to obtain crepitus if a fracture of the ribs is suspected; such cases should be treated as if the diagnosis were certain. Should the ribs be merely bruised, the rest and support afforded by the treatment will relieve the pain. An X-ray photo will be of use in doubtful cases.

The chief importance of these injuries lies in the *complications* which may accompany them, and foremost among these are the injuries to the intra-thoracic organs. For example, the pleura may be punctured and the intercostal artery may be torn, and hæmorrhage may occur both into the subcutaneous tissues and into the pleural cavity, leading to a *hæmo-thorax*, or the lung may be punctured and air may escape from it into the pleural cavity—*pneumo-thorax*; when the latter occurs, it is not uncommon for the air to escape through the wound in the parietal pleura also and become diffused in the subcutaneous tissues, giving rise to *surgical emphysema*. When the fractured ends perforate the lung, there will also be *hæmoptysis*; this may, however, occur as the result of severe compression of the chest, causing actual *contusion of the lung* without any direct injury to it by the fractured ends. Other viscera—such as the kidney, the liver, the spleen, or even the stomach—may be wounded when the lower ribs are the seat of fracture. Among the more remote complications are *pleurisy*, which is not at all uncommon at the seat of the fracture; *pleuro-pneumonia*, when the lung has been damaged; *œdema of the lung*, which is commonest in old people; *bronchitis*, also frequent in old people, especially when they have been previously subject to that affection. It may happen that bronchitis is actually present at the time of

the accident, and the latter then aggravates the condition because the patient cannot empty the bronchial tubes properly, partly on account of the pain, and partly because of the involuntary fixation of the affected side of the thorax. If a number of ribs are broken, the affected side of the thorax may not move at all, and this absence of movement is probably the main cause of bronchitis when it occurs as a direct result of the injury.

Fractures of the ribs usually unite firmly in three or four weeks, even when no particular steps are taken to secure accurate co-aptation and fixation of the fragments. It is very seldom that non-union occurs, and, even should it do so, it is of little consequence, provided that only one or two ribs be injured. The callus is small in amount, and at a later period there may be no sign of the injury having occurred beyond slight thickening at the seat of fracture. Not uncommonly, the patient complains of a good deal of pain at the seat of the fracture for some time afterwards.

TREATMENT.—Of the fracture itself.—*When only one or two ribs are broken* it is not necessary to make an attempt to get the fractured ends into position, as a few deep inspirations will do this, and the sound ribs will prevent subsequent displacement. Even after puncture of the lung, displacement is usually only transitory, but when a number of ribs are fractured there may be considerable deformity; even here, however, it is not necessary as a rule to attempt co-aptation. Should the fractured ends be driven in and penetrate the lung, it may be necessary to cut down upon the seat of fracture and deal with whatever condition is found in the most suitable manner; this, however, is very rarely required.

Most simple fractures of the ribs heal well without anything being done for them; rest in bed in the semi-recumbent position for a few days, the application of an ice-bag or an evaporating lotion to diminish congestion, and the administration of morphine for the relief of pain or restlessness, will usually suffice.

Strapping the ribs.—In some cases, however, it is advisable to restrain the movements of the ribs by the application of strapping (see Fig. 55), but this should never be carried to such an extent as to interfere with respiration, especially in old subjects. Three or four strips usually suffice, as it is unnecessary to fix the entire half of the thorax. The best plan is to apply one strip, about three inches broad, over the line of the fractured rib, commencing just beyond the middle line in front and extending to beyond the spine behind; this should be put on during moderate expiration. Outside this, two or three more pieces may be applied, crossing each other somewhat obliquely over the seat of fracture. There is no doubt that a support of this kind relieves the patient and keeps the parts steady. No bandage should be put on, as this would interfere with the movements of the opposite side.

In old people, especially in bronchitic subjects, it is questionable whether any restrictive apparatus should be employed at all. At most, two or three pieces of strapping may be applied, as above directed, and the patient should be propped up into the semi-recumbent position as early as possible. The use of strapping should be avoided altogether when there is any suspicion of the ribs being pressed inwards, as it will only increase the damage done by their fractured ends.

When many ribs are fractured, strapping should be dispensed with; the patient should be kept in bed in the semi-recumbent or the most comfortable posture, and, as a rule, the pain involved in breathing will cause the affected side of the chest to be fixed involuntarily and sufficiently to prevent undue movement. When the patient is able to get up, strapping the whole of the lower half of the affected side in the classical manner from below upwards, will give considerable relief provided no bronchitis is present, and will enable the patient to get about. The administration of opium or morphine is very useful in cases of fractured ribs; it eases the pain and diminishes cough, and hence it should be given from the first if there is no contra-indication, such as the presence of renal disease.

After-treatment.—When there is a simple fracture of one or two ribs, without displacement, the patient need not be confined to bed for more than two or three days; but vigorous exercise must be prohibited for two or three weeks, and the arm on the affected side should be carried in a sling. It is most important that old persons should be allowed to sit up as soon as possible, as this is the best preventive of lung complications.

When the fracture is compound it must be treated on the ordinary lines for compound fracture (see Vol. II.). The injury is rare; but when it occurs, the pleura is generally torn, and some of the complications referred to above are present and will require to be treated on appropriate lines.

During the disinfection of the wound, care must be taken not to allow strong antiseptics to pass into the pleural cavity, and also not to open up the rent in the pleura unnecessarily. Should the injury have occurred some time before the surgeon sees the patient, and should septic infection of the pleura have already taken place, it is well to excise the ends of the fractured ribs and establish proper drainage of the pleural

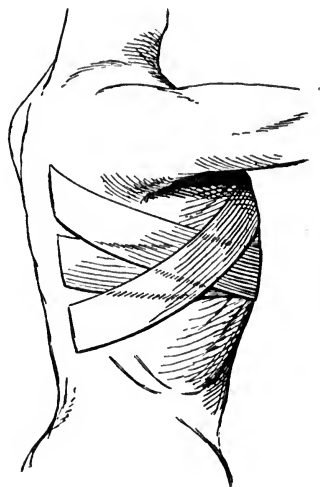


FIG. 55.—STRAPPING APPLIED FOR FRACTURED RIBS.

cavity. The treatment of these cases is similar to that for empyema (see Chap. XVII.).

Of complications.—It is only necessary to refer here to the pulmonary complications, such as bronchitis or pneumonia, and to emphysema. Other affections, such as pneumo- and hæmo-thorax, are considered elsewhere.

Lung complications, such as bronchitis or pneumonia, must be carefully watched for, and appropriate remedies—jacket-poultices and the use of a steam-kettle, combined with the administration of expectorants and diffusible stimulants such as carbonate of ammonia, brandy, or vinum ipecac.—should be employed as soon as the first symptoms appear, and the patient should be propped up as nearly in the upright position as possible. If the breathing becomes increasingly difficult from the engorgement of the right side of the heart—as will be denoted by lividity of the extremities and a full bounding pulse—venesection (see Vol. I. p. 4) from the arm to the extent of eight or ten ounces will do much good, and may be repeated if necessary in vigorous subjects; in those who are less able to bear the loss of blood, the inhalation of oxygen is valuable if begun sufficiently early, and it may be maintained for a long time.

Surgical emphysema.—This seldom calls for any treatment, as the emphysema rarely does any harm—the air being sterile, and becoming rapidly absorbed as soon as its further escape into the tissues ceases. It rarely interferes with respiration, as it usually spreads from the seat of injury over the affected side of the thorax, and it only makes its appearance in the neck when it escapes in large quantities. When the injury to the pleura occurs very high up, the air may, however, extend into the cellular tissue of the neck and may then so seriously interfere with respiration that it becomes necessary to let it out. This can easily be done by puncturing the skin in several places with a tenotomy knife over the distended area. In doing this it is important not to withdraw the knife immediately the puncture has been made, but to turn it at right angles to the axis of the small incision so as to keep the aperture open and allow the air to escape. Small gauze and collodion dressings are applied over the punctures afterwards.

DISLOCATION OF THE RIBS.

The vertebral ends of the ribs are sometimes dislocated, generally as part of a very severe crush, but the accident is usually only recognised *post mortem*. Even were it recognised during life, it would be impossible to reduce the dislocation, and no special treatment would be necessary apart from that of the other injuries which may be present.

INJURIES TO THE COSTAL CARTILAGES.

These may take the form of fracture of the cartilages, or separation between them and the ends of the ribs. Fracture is most common at an advanced age when extensive calcification of the cartilage has occurred, whilst separation of the cartilages from the ribs is more frequent in adult life. These accidents are generally due to severe direct injury, and fracture usually occurs towards the costal end of the cartilage, those most frequently injured being the lower ones—the eighth more often than the others. The treatment is similar to that for fracture of the ribs (see p. 196).

DISLOCATION OF THE COSTAL CARTILAGES FROM
THE STERNUM.

When this rare injury occurs, the end of the cartilage usually projects forwards in front of the sternum ; occasionally, however, it may be situated behind that bone.

TREATMENT.—An attempt should be made to get the end of the cartilage into position by making the patient lie upon the back with a firm narrow pillow or sand-bag between the scapulæ, and take a deep inspiration. When the cartilage is dislocated behind the sternum, re-position is not easy without exposing the seat of injury by operation, when the cartilage can either be pulled back into place or, failing that, a portion may be excised. It is always advisable to operate when the end of the cartilage is driven backwards, otherwise injurious pressure may be caused. When re-position has been effected, the treatment is similar to that for fractures of the ribs (see p. 196).

FRACTURE OF THE STERNUM.

This injury is usually part of a severe crush of the thorax, and the fracture may occur at any part of the bone, but is most common at the junction of the manubrium with the gladiolus. It is generally a fracture-dislocation, although it may occasionally be a true separation at the joint ; there is usually little displacement ; if there is, the lower fragment occupies a plane somewhat anterior to the upper.

TREATMENT.—If the depression is slight and does not cause symptoms, nothing need be done ; otherwise the displacement may sometimes be reduced by hyper-extending the upper dorsal spine over a large sand-bag, when the two fragments are disentangled and come into position. Should this fail, the seat of injury may be exposed by turning up a flap and elevating the depressed fragment, and if necessary fixing it by a plate and screws.

DISLOCATION OF THE XIPHOID CARTILAGE:

The ensiform process occasionally becomes bent backwards so that the tip presses inwards on the epigastrium, and obstinate dyspeptic troubles, such as pain and vomiting, may result. Excision of the process will give complete relief to these symptoms. Should the displacement be recognised immediately it occurs, an attempt may be made to reduce it by manipulation, but this is not easy; if it is unsuccessful, time should be allowed to elapse in order to see whether the displacement causes trouble.

CHAPTER XVII.

INJURIES OF THE THORAX AND ITS CONTENTS.

INJURIES OF THE THORACIC WALL.

THE importance of injuries of the thoracic wall depends largely upon whether the thoracic viscera are also damaged or not.

CONTUSIONS OF THE CHEST.

These are generally due to severe compression—as in run-over accidents—from the impact of a spent bullet, or from a fall. The injury to the soft parts is comparatively trifling, but there may be considerable bruising or laceration of the muscles. These contusions may be accompanied by fracture of the ribs (see Chap. XVI.), or there may be severe intra-thoracic damage without any fracture. The relative frequency of visceral injury with or without fracture of the ribs depends partly on the age of the patient and partly on the nature and severity of the injury. In young children the ribs will bear much compression without undergoing fracture, and in them it is not uncommon to get severe injury to the thoracic viscera alone. The rapidity with which the blow is struck is also of importance, as slow compression of the chest wall gives rise to less damage than a sudden sharp blow, because in the former case the viscera have time to accommodate themselves to the altered shape of the thorax.

A peculiar condition, termed 'concussion of the chest' or 'commotio thoracica,' is sometimes met with, in which there is fatal collapse as the result of an injury, and yet on *post mortem* examination no definite lesion can be found. This condition is commonly attributed to direct injury to the intra-thoracic portion of the vagus, but paralysis of the sympathetic has also been suggested; it is also possible that it may be the result of direct compression of the heart.

TREATMENT.—The first indication in severe concussion of the

chest is to place the patient in the horizontal position with the head dependent; if necessary, artificial respiration is carried out until the power of normal breathing returns. Brandy or ether may be injected subcutaneously, and friction applied to the surface of the body. Stimulants should be given by the mouth when the patient can swallow, or injected subcutaneously when he cannot.

WOUNDS OF THE THORAX.

These are generally divided into penetrating and non-penetrating wounds, according as the pleural cavity is opened or not, and the gravity of the injury depends mainly on this point.

NON-PENETRATING WOUNDS.—The only point of special importance in connection with non-penetrating wounds of the thoracic wall is the occurrence of hæmorrhage, which may proceed from the intercostal or the internal mammary arteries. These vessels may also be wounded in the course of operations without penetration of the thoracic cavity, but in accidental wounds hæmorrhage from them is practically always associated with penetration.

Wounds of the internal mammary artery are very rare and are generally due to stabs or bayonet wounds. The bleeding is very free and may take place either externally or into the pleura, the pericardium, or the anterior mediastinum. The artery may be wounded in any part of its course and the diagnosis is easy when the bleeding occurs externally, but is difficult when the blood only escapes into the thoracic cavity; it must then be arrived at by the position of the wound, the increasing anæmia, the signs of loss of blood, and the indications of intra-thoracic pressure. The artery arises from the subclavian at a point nearly opposite the vertebral artery, and passes forward to the anterior thoracic wall, behind which it runs almost vertically downwards about half an inch outside the border of the sternum and superficial to the parietal pleura and the thoracic fascia. At the level of the fifth intercostal space the artery divides into its musculo-phrenic and superior epigastric branches.

Wounds of the intercostal artery are rarely met with, and are commonly the result of stabs and gunshot wounds. The bleeding may occur into the thorax or outwards through the wound, or in both directions, simultaneously; there is also extravasation into the cellular tissue of the thoracic wall. There are two intercostal arteries in each space from the level of the angle of the scapula forwards: the one, a small vessel running along the upper border of one rib, and the other, much larger and accompanied by the intercostal nerve, beneath the lower border of the rib above.

Treatment.—A bleeding *internal mammary* artery must be secured as soon as possible; unless this is done, the patient may die of hæmorrhage.

The wounded vessel must be tied above and below the point of injury, and in the first instance an attempt should be made to secure it through the wound; as, however, the intercostal space is narrow, it may be necessary to remove the costal cartilage above and below the seat of injury. The best plan is to plug the wound temporarily and then to carry incisions upwards and downwards so as to expose the costal cartilages above and below the seat of injury. About an inch of the upper costal cartilage is removed after detaching the perichondrium, and after dividing the perichondrium and fascia behind the cartilage, the two ends of the vessel may be secured. If the lower end has retracted behind the costal cartilage below the seat of injury, as it not infrequently does, a portion of that cartilage must also be taken away. The wound should then be disinfected and drained. Any complication, such as hæmo-thorax, hæmo-pericardium, or pyo-thorax, which may arise later, must be appropriately treated.

The obvious treatment of a wound of an *intercostal artery* is to open up the wound, find the source of the bleeding, and tie the vessel; but this is usually difficult, unless a portion of the rib above the wound is resected or the periosteum separated from the lower border of the rib. Time will be saved by cutting down on the rib above the wound, detaching the periosteum rapidly and fully, and then removing about an inch and a half of the bone. This exposes the intercostal vessel, and the two ends may be picked up in forceps and tied. If there is any difficulty in doing this, the vessel may be underrun with catgut on a fully curved needle. Excision of a portion of the rib leaves no weakness of the thoracic wall, and there is no reason why the surgeon should be content with such clumsy expedients as passing an aneurysm needle around the rib and tying a ligature over that structure so as to press the vessel against its lower border, or employing a tampon which is very liable to be followed by sepsis and is also not efficient.

PENETRATING WOUNDS.—These are much more serious on account of the numerous complications that may accompany them; in addition to wounds of the vessels already mentioned there may be injury to the lung, pleura, pericardium, heart, great vessels, diaphragm, œsophagus, trachea, or thoracic duct. As a sequel to these injuries, hernia of the lung may be met with, or complications such as hæmo-thorax, pneumo-thorax, pyo-thorax, suppurative mediastinitis, or pericarditis. All these conditions are dealt with separately.

Penetrating wounds of the chest may be due to stabs, gunshot wounds, or extensive contusions. The prognosis depends on the cause of the injury and on the occurrence of bleeding or sepsis.

Treatment.—The wound must be disinfected, care being taken to see that no strong antiseptics run into the pleural cavity. In military surgery the possibility of the presence of a foreign body in the wound—such as a piece of the clothing—must be borne in mind, and if present

this should be found and removed. The patient should then be kept absolutely at rest in bed, lying on the injured side, and it is important not to employ too vigorous measures to counteract the shock from which the patient always suffers, because the faintness produced by the severity of the injury is valuable in stopping hæmorrhage, especially when the lung has been injured; free hæmorrhage from the lung, which might well prove fatal, may recur if stimulants are employed. Leiter's tubes or an ice-bag should be applied to the affected side of the chest outside the dressing. Ice should be given to suck, and morphine may be administered hypodermically. The further steps in the treatment will be largely influenced by the presence or absence of blood or air in the thoracic cavity.

Of wounds of the pleura.—*When the hæmo-thorax or pneumo-thorax is only slight* and does not incommode the breathing, the best plan is to close the wound leading into the pleural cavity by fine sutures, and then, after disinfection of the superficial wound, to introduce a small drainage tube into it for a few days, and either leave it open or partly close it by sutures.

When there is a rapid formation of hæmo-thorax, it is well to enlarge the wound, clear out the blood, and search for the source of the bleeding. If it comes from an intercostal vessel, it is easy to secure it (see p. 203), but if the bleeding is due to injury of the lung, its arrest is a much more difficult matter (see p. 208).

When *pneumo-thorax* occurs in connection with an external wound, however, it seldom gives rise to serious pressure symptoms, because the air finds its way out through the opening in the thoracic wall and passes into the cellular tissue.

Of prolapse of the lung.—Prolapse of the lung through the wall of the thorax is rare, and may occur either at the time of the accident or subsequently. It is most commonly met with in extensive injuries, such as shell-wounds, and is probably due to the glottis being closed at the moment the injury is sustained. The prolapsed portion of the lung becomes caught between the ribs and fixed there, and undergoes considerable congestion from the pressure; it may ultimately become gangrenous.

If the case is seen immediately after the accident, it is only necessary to disinfect the surface of the lung, free it, and return it into the thorax, bringing the skin together over it. If, however, the case is not seen until some time has elapsed and firm adhesions have occurred between the opposed surfaces of the pleura, reduction may be inadvisable. If the prolapsed portion is inflamed or gangrenous, it should be left *in situ* and allowed to slough off. The process may be hastened by tying a ligature tightly around the base of the prolapsed portion and cutting off the necrotic area.

Consecutive hernia—that is to say, a hernia occurring through the seat

of an injury some time after healing has taken place—is comparatively rare, and results either from adhesion of the lung to the seat of the injury or from emphysema developing later, or possibly from both causes combined. A properly fitting corset with a suitable pad, or an apparatus of the nature of a truss with shoulder- and chest-straps, should be applied. Sometimes a cure has been accomplished by such means; if not, the protrusion may be returned and a radical operation performed under differential pressure (see Chap. XIX.).

Of traumatic empyema.—This is not uncommon after a penetrating wound of the thorax, and, when it occurs, the sooner the thorax is opened and drained the better. The incision should be free, and is best combined with resection of a rib (see p. 221). When the affection follows a wound, it may suffice to enlarge the old wound and drain the pleura through it; if, however, the primary opening is comparatively high up in the thoracic wall, it is well to pass a probe down to the lowest limit of the pleura about the posterior axillary line and make a counter-opening in that situation after excising a portion of the rib. A drainage tube can then be passed from one opening to the other, and the after-treatment will be similar to that for empyema (see p. 223).

Of foreign bodies in the thorax.—Bullets or fragments of clothing may be met with in the pleural cavity or in the lung. If they remain aseptic, as bullets sometimes do, they may gravitate to the lowest part of the pleural cavity and become encapsuled. If sepsis occurs and the foreign body is not removed, an acute empyema or an abscess of the lung may form, according to its position, and the pus may be discharged either through the wound or into one of the bronchi; in the latter case fatal septic pneumonia is likely to occur.

Should the object be opaque to the X-rays, it can be localised by them and cut down upon and removed, if it is in an accessible position, and this proceeding is much simplified by the use of differential pressure (see p. 232). If it can be reached from the wound, the simplest plan is to open up the latter and remove it by that route; in other cases it may be some considerable distance away (as is often the case with bullets), and then it may be removed by a fresh incision close to the foreign body.

When the foreign body is a fragment of clothing and cannot be localised by the X-rays, the wound should be opened up and the track of the sinus examined carefully until the foreign body is felt. If it can be removed through the wound this should be done; if not, its exact situation should be ascertained and the thorax should be opened in the most suitable situation. Drainage must be employed subsequently.

If the case is not seen until some time after the accident, either the foreign body will be quiescent, or symptoms of empyema or pneumonia will have developed; the case then becomes either a pulmonary abscess or an empyema, and must be treated accordingly (see p. 241 and p. 220).

INJURIES TO THE THORACIC CONTENTS.

These form a much larger group of cases, and may result from compression of the chest, from fractures of the ribs, or even from muscular action.

INJURY OF THE DIAPHRAGM.

This usually occurs as a part of a very severe injury, but it is sometimes due to bayonet or gunshot wounds; rupture has also been known to occur from violent straining. The opening in the diaphragm may be large or small and the left side is most often affected. Various abdominal viscera may find their way through the opening into the pleural cavity, giving rise to the so-called 'diaphragmatic hernia,' which, however, is not a true hernia as it possesses no hernial sac.

The *symptoms* vary according to the nature of the injury and also according to the particular structure that has passed through the rent in the muscle. Diaphragmatic respiration is much reduced or altogether abolished; there is great pain, which is increased on deep respiration or coughing; there is also considerable difficulty in breathing, and, before long, vomiting and various other symptoms may set in as the result of strangulation of the herniated parts. Symptoms of pleurisy develop after a short time. The percussion note is markedly altered according to the nature of the organ that has passed through the opening, and variations in the extent and situation of the note occur as more and more of the abdominal viscera enter the thorax. The heart may be displaced. A radiogram may be of much help in the diagnosis. The *prognosis* is not good, but a certain number of cases have been operated on with satisfactory results.

TREATMENT.—Operative interference takes the form of a laparotomy through an incision parallel to and about an inch below the border of the ribs; the diaphragm is exposed at once, the exact condition of affairs ascertained, the prolapsed organs restored to the abdomen, and the rent in the diaphragm stitched up. Although the hernia has been generally approached from the abdominal cavity, it might be easier to reach it through the pleural cavity after resecting two or more ribs or turning back a flap containing the soft parts and the underlying ribs; the operation should be done under differential pressure (see Chap. XIX.).

Diaphragmatic hernia.—True hernia, caused by protrusion of some of the abdominal contents through an abnormal opening in the diaphragm, is very rare. In the majority of cases, the condition has either been found *post mortem* or in the course of a laparotomy for acute intestinal obstruction. An attempt should be made to reduce the hernia after laparotomy and to suture the aperture in the diaphragm through which it has found its way.

INJURIES TO THE PLEURA AND LUNG.

These are the commonest visceral lesions in severe contusions of the chest; the air does not escape sufficiently quickly from the lung when the compressing force is applied, and consequently its tissue is torn. This is most likely to happen when the lung is full of air and the glottis is firmly closed at the time the injury is received. Extensive damage may be done to the lung without any sign of external injury or fracture of the ribs.

The actual injury varies considerably. In slight cases only a few air-cells or blood-vessels may be ruptured; the visceral layer of the pleura may remain intact and blood may be extravasated into the lung tissue, a certain amount finding its way into the bronchial tubes and so becoming expectorated. In these cases there is merely some slight pain and cough; and the patient expectorates blood-stained mucus.

In more severe cases, however, the lung substance may be torn to a considerable extent and the pleura ruptured over it, and then blood and air will escape into the pleural cavity and a pneumo-hæmo-thorax will result. The bleeding will probably be profuse when the rupture is extensive, and the amount of air present will then be of secondary importance. There will be dullness over a large area of the pleural cavity and over the seat of injury; in the latter situation there will be crepitations. Hæmoptysis also occurs.

The *prognosis* depends entirely on the extent of the injury. When this is comparatively slight and there is no serious pneumo- or hæmo-thorax, recovery is usually rapid, except in feeble or elderly subjects in whom the injury may form the starting-point of pneumonia. When, however, there is extensive damage, accompanied by extreme shock, profuse hæmoptysis and immobility of the affected side, the risk is very serious not only from the immediate effects of the injury, but also from the risk of infection of the extravasated material which may arise when the larger air-passages are opened up. It would appear that infection does not occur when the terminal branches of the bronchi alone are in communication with the extravasated blood, as the bacteria are apparently filtered out of the air by the time it reaches that part of the lung.

TREATMENT.—**Of uncomplicated cases.**—The patient should be put to bed and, after recovering from the shock, should be propped up in the semi-recumbent position, with a large ice-bag or Leiter's tubes applied to the affected side of the chest. If the dyspnœa is considerable, a hypodermic injection of morphine will relieve it, and under this treatment most of the mild cases will recover. The patient should not be allowed to get up until all the physical signs have disappeared from the chest.

Of complicated cases.—The most serious cases are those in which air or blood is present in the pleural cavity.

When there is hæmo-thorax, cold should be applied to the affected side of the chest in order to check the bleeding. Internal styptics, such as calcium lactate (ʒj, *per rectum*), ergotinine citrate (gr. $\frac{1}{10}$, hypodermically), and gallic acid (gr. xv), may be tried, and will probably arrest the hæmorrhage, unless a large vessel has been wounded. Morphine should be given if there is restlessness.

It was formerly an open question whether an attempt should be made to open the thorax and try to secure the bleeding point. Should the hæmorrhage come from an intercostal artery or the internal mammary, it will be necessary to do so; but when it is due, as it commonly is, to tearing of a lung and oozing from its surface, or when the bleeding comes from one of the larger pulmonary vessels, the chances of dealing successfully with it after opening the thorax are not good. The introduction of differential pressure methods (see p. 232) have, however, made these operations much more feasible, as they prevent the collapse of the lung which otherwise occurs. The situation of the thoracotomy will be determined by the position of the wound if one is present; if there is no wound, the operation should be done from the side. The thorax is opened by removing several ribs or turning aside a large flap containing the ribs and soft parts. The important thing is to have enough room; so that the whole hand may be passed into the pleura and the lung pulled into the wound for examination. All clots are removed and the lung inspected. A small wound in it can be closed with mattress sutures; if it is irregular and jagged, it may be necessary to resect the piece of the lung before bringing the raw surfaces together. Fine catgut is the best material for the sutures, and these should be passed close to the edges of the rent and not tied too tightly. The edges of the wound in the parietal pleura should be united by separate sutures. When the arrest of the hæmorrhage is not satisfactory, the lung may be fixed to the opening in the thorax, and the thoracic wound partly closed, the differential pressure being maintained, until the operation has been completed so as to prevent the entrance of air into the pleural cavity.

The surgical treatment of hæmo-thorax after active bleeding has ceased will be mainly directed to the relief of pressure. If blood is poured out into the pleural cavity in large quantity, it will exert injurious pressure upon the lung and interfere with breathing to such an extent that some of it must be removed. At the same time, it is well not to be unduly hasty in removing the blood, as its pressure may act beneficially in stopping the hæmorrhage; and as soon as the bleeding stops, the fluid is rapidly absorbed from the pleura and the pressure diminishes.

If it is necessary to relieve the intra-thoracic pressure, this should be done by puncturing the fifth or sixth intercostal space in the mid-axillary line with a large hollow needle. The patient should be placed in the recumbent position, a small incision made in the skin, and the

needle pushed into the thorax midway between two ribs. The patient should be told not to breathe deeply, and the aspirating-bottle should not be used ; it is enough to allow the fluid blood to flow out, and no more should be withdrawn than is necessary to relieve the pressure. It is better to repeat the tapping than to take away too much blood at one time ; drainage of the pleural cavity should not be employed.

Pyo-thorax will follow hæmo-thorax if infection of the extravasated blood occurs. Its treatment will be similar to that of empyema (see p. 220).

Pneumo-thorax may complicate the hæmo-thorax—the condition being then known as *pneumo-hæmo-thorax*—or there may be very little blood effused and so much air that the term pneumo-thorax alone suffices to indicate the state of matters. This condition may also occur as the result of other injuries than contusions of the chest. It is common after fracture of the ribs and penetrating wounds of the chest ; in these cases the lung collapses, and air passes into the pleural cavity from the lung at every inspiration, and if the opening is valvular, the air does not escape on expiration. Pneumo-thorax may also occur in connection with rupture of tuberculous cavities and some diseases of the abdominal viscera.

The affected side of the thorax is more or less immovable, the heart may be displaced, and in severe cases the intercostal spaces may bulge considerably. There is a tympanitic note on percussion, and the breath-sounds are distant or absent. As a rule, suppuration does not occur when there is no external wound, because the air is apparently filtered in the smaller bronchi before it reaches the pleura ; suppuration, however, is not at all infrequent when the pneumo-thorax is caused by a penetrating wound of the chest.

The pneumo-thorax usually disappears spontaneously unless it is due to an external wound or to an extensive rupture of the lung, and nothing need be done provided that no great dyspnœa is occasioned. When, however, the pressure symptoms are marked, or when the air is not rapidly absorbed, the pleural cavity should be punctured with a trochar and canula and some of the air let out. The very strictest precautions must be taken to secure asepsis, otherwise an empyema will result. If the air rapidly reaccumulates, showing that a large bronchiole is damaged, an opening should be made into the thorax, and a canula provided with a valve of rubber tissue at its outer end inserted.

INJURIES OF THE PERICARDIUM.

These are necessarily very serious. Injury to the pericardium rarely occurs alone, as the heart and great vessels are usually implicated, and then death may be due to hæmorrhage or shock or both. When the

injury results from fracture of the ribs, sternum, or costal cartilages, the parietal pericardium alone may be torn, but when it is due to a penetrating wound, the heart is generally also punctured.

TREATMENT.—Injury to the parietal pericardium requires no treatment *per se*, but when it is associated with an external wound the parts must be disinfected, and if there is any likelihood of sepsis, a drainage tube should be introduced, which just projects into the pericardial sac. The external opening of the tube should be covered by a piece of protective, so as to prevent the entrance of air. A clean, punctured wound should be closed immediately, without drainage—careful watch being kept for sepsis; if the wound becomes septic, suppurative pericarditis will occur, and the wound must then be opened up and the pericardium drained.

Occasionally, a wound of the pericardium may be accompanied by severe hæmorrhage into the pericardial sac without the heart being wounded, and under these circumstances the case may prove fatal from the pressure of the effused blood upon the heart. If there is any evidence of this, it is well to insert a drainage tube through which the blood may escape and so relieve the pressure upon the heart. Should the pressure continue in spite of this treatment, it will be necessary to open up the wound freely and attempt to secure the bleeding point.

Injury to the great vessels requires no description, as it is necessarily immediately fatal.

INJURIES TO THE HEART.

These may take the form of rupture of the organ, severe compression, punctures caused by stabs or bullet wounds, or injuries from fractured ribs.

Rupture of the heart generally occurs from severe run-over injuries, and is usually immediately fatal either from shock or hæmorrhage; if death is not immediate, it soon follows from hæmorrhage into the pericardium.

Wounds of the heart are usually penetrating wounds; nearly 90 per cent. of the cases belong to this class. The prognosis is extremely bad—particularly when the auricle is wounded; the least fatal cases are those in which the apex of the organ is involved. It is said that about 10 per cent. of all cases of wounds of the heart have recovered from the immediate effects of the injury, but death may occur subsequently from yielding of the scar and the formation of an aneurysm, or from endocarditis, myocarditis, or pericarditis. Secondary rupture of the heart is also known as a result of giving way of the scar.

TREATMENT.—In some cases in which the surgeon has been called to a patient suffering from a wound of the heart, in whom the hæmorrhage has not been very great, the wound has been opened up and the incision in the heart has been sutured. The organ is best reached by an incision

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along the fourth left intercostal space about four inches long, commencing half an inch from the sternal margin ; at the outer end a second incision is carried as far down as the seventh rib. A portion of the fifth costal cartilage is removed and the pleura either pushed to the left side, or if it is impossible to avoid opening it, the parietal and visceral layers are sutured together before it is divided so as to prevent the occurrence of pneumo-thorax. A better plan, when it is possible to employ it, is to use differential pressure (see p. 232), in order to avoid post-operative pneumo-thorax. Sauerbruch and Hacker have found that the best pressure to use is 3 mm. Hg ; and after the suture of the heart has been completed, to raise the pressure to 7 or 8 mm. Hg, whilst the pleura (which may under these circumstances be deliberately opened) and the chest wall are being closed. The clot is turned out and the heart is thoroughly exposed.

There appears to be no special difficulty or danger in exposing and suturing the heart, the chief point of importance being the extent of the wound in it. The sutures should be of fine catgut, and should pass fairly deeply through the substance of the ventricle without taking up the endocardium. As soon as the wound in the heart has been sutured, it will probably be advisable to have recourse to stimulants, intravenous infusion, or other measures suitable for the relief of the shock (see Vol. I. p. 118). The pericardium is closed, either entirely or after the introduction of a small catgut drain, which may be left out on the second day. Subsequently, the administration of morphine and digitalis may be called for.

INJURIES OF THE MEDIASTINUM.

These are generally part of very severe injuries and are apt to be followed by immediately fatal hæmorrhage. If the patient recovers there may be septic mediastinitis, and drainage will be necessary.

PENETRATING WOUNDS OF THE LUNGS.

These injuries may be caused by stabs, gunshot or penetrating wounds caused by falls on to such things as railings. They are important in the first place because there is an open wound, and therefore a considerable risk of sepsis ; in the second place a foreign body may be retained in the chest ; in the third place, there may be severe injury to viscera other than those in the chest—the abdominal viscera being often implicated in stab and bullet wounds—and careful examination must always be made to find out if such injuries are present.

Bullet wounds occur in both civil and military practice. In civil practice they are usually produced by bullets of low velocity, which remain embedded in the lung or the opposite side of the chest, and their

chief danger arises from the fact that foreign bodies—such as pieces of clothing—may have been carried into the wound as well. In military practice the wounds are due to a high-velocity bullet which inflicts little damage on the lung itself and does not remain in the chest, but usually passes through the body or is diverted to other parts; it rarely carries foreign materials in with it. A certain amount of shock, some hæmoptysis and cough, with the occurrence of hæmo-thorax and pneumo-thorax, are the usual signs of these injuries. It is an important point that in warfare the extent of the hæmo-thorax is greatly influenced by the subsequent transport of the patient. The greater the distance the patient has to be moved, and the rougher the means of transport, the more likely is a hæmo-thorax to follow. The hæmoptysis may persist for some time. Empyema rarely follows the hæmo-thorax caused by small bullets, and spontaneous absorption of the blood is not infrequent. The hæmo-thorax is often accompanied by a rise in temperature which may continue for several days.

TREATMENT.—This is essentially conservative, rest and the usual treatment to combat shock and arrest hæmorrhage being employed in the first instance. High-velocity bullets lodged in the lung or spine may be left alone if they cause no trouble; if they do, the position of the bullet should be determined by a stereoscopic radiogram, and, if in an accessible position, it should be removed at once, if circumstances permit, especially if there is any doubt as to the presence of other foreign bodies. In the absence of symptoms, there is no need for immediate operation; but if the bullet is embedded in the lung and the operation can be done under differential pressure, it is advisable to remove it before extensive changes are set up. It is possible to remove such a foreign body successfully without the aid of differential pressure, but there is considerable risk of pneumo-thorax occurring to such a degree as to embarrass the respiration and also of subsequent pyo-pneumo-thorax.

CHAPTER XVIII.

INFLAMMATORY AFFECTIONS OF THE THORAX AND ITS CONTENTS.

ACUTE OSTEO-MYELITIS OF THE THORACIC WALL.

ACUTE infective osteo-myelitis in its typical severe form seldom affects either the ribs or sternum, but a less severe or sub-acute form is not uncommon as a sequela of typhoid fever and also in children in connection with acute osteo-myelitis affecting other bones.

The *symptoms* are similar to those of the disease elsewhere (see Vol. II. p. 432), but are generally less acute in character; necrosis of the portions of the ribs or sternum affected commonly follows. The temperature is high and there may be rigors and septicæmic symptoms accompanied by the formation of a tender swelling over the affected area, the skin over which becomes œdematous and boggy and soon shows fluctuation. The sequestrum usually becomes loose in about six weeks and only involves a portion of the bone.

TREATMENT.—This is the same as for septic osteo-myelitis in general (see Vol. II. p. 433). The parts should be thoroughly exposed at the earliest opportunity, the pus evacuated, and the wound left open. It is best not to remove any portion of the rib in the first instance, but to wait for the separation of the sequestrum, which is then taken away in the usual manner (see Vol. II. p. 444). In cases following typhoid fever, however, the typhoid bacillus may remain in the medulla of the bone for a long period and, even if the sequestrum is taken away, healing may not occur and fresh inflammation may be set up. Hence, in these particular cases, we are inclined to depart from the general rule and remove the whole portion of the rib which is the seat of inflammation, so as to make sure of getting rid of the focus of disease.

SYPHILIS OF THE RIBS OR STERNUM.

This takes the form of gummata, and the upper part of the sternum is most frequently affected. When the disease affects the ribs, the first rib is the one usually attacked, near its junction with the sternum and the clavicle, and all three bones may be involved in the gummata mass. As a rule it is not accompanied by any extensive necrosis.

TREATMENT.—In the early stages this is similar to that of gummata elsewhere (see Vol. I. p. 224), and the administration of salvarsan or iodide of potassium in combination with mercurial treatment often causes the gummata to disappear without the occurrence of any necrosis.

When necrosis has occurred and an open wound is present which will not heal under anti-syphilitic treatment, it is well to remove the sequestrum and the diseased bone around in a manner similar to that for tuberculous disease (see p. 215). If this is done, and if the anti-syphilitic treatment is kept up, the wound generally heals readily.

TUBERCULOSIS OF THE RIBS AND STERNUM.

This affection is quite common, and is often set up by injury. It usually starts beneath the periosteum about the insertion of the intercostal muscles, but it may begin as a deposit in the interior of the bone. These deposits are often multiple, and may occur at more than one spot in the same rib, or, more frequently, in several ribs one after the other. The most common seats of tuberculous disease of the ribs are either behind the posterior axillary line or at the junction of the costal cartilages either with the ribs or with the sternum. The sternum is also sometimes affected, generally at the junction of the manubrium with the gladiolus.

The *symptoms* are generally very indefinite at first, and the patient often does not realise that anything is wrong until a swelling is accidentally found upon the chest. In the early stages, however, there may be ill-defined thoracic pain, followed after a time by an indefinite thickening over the affected area, which subsequently softens and gives rise to an abscess.

When the ribs are affected, the abscess generally forms on the outer surface, but when it has attained any size it usually also spreads to the deeper aspect of the bone, and may lie not only between the rib and the superficial structures, but also between the rib and the pleura. This will give rise to an impulse in the tumour on coughing, and it is not uncommon for the case to be looked on as a localised empyema finding its way through the intercostal space; when the abscess implicates

the external surface of the rib only, there is no impulse on coughing. It is very important to remember that these abscesses may not point over the diseased area, but may make their way forward between the intercostal muscles for some distance before they turn outwards, and therefore, before operating, a careful examination must be made to find the thickened portion of the rib from which the abscess takes its origin. Abscesses occurring in connection with caries of the dorsal vertebræ may also travel forward between the ribs and point in a similar manner; every chronic abscess pointing on the side of the thorax is not necessarily due to caries of the rib.

The *prognosis* depends largely on the treatment adopted. The abscess, if left alone, will ultimately burst through the skin, and an intractable sinus leading down to carious bone will be left and fresh sinuses may form.

When the sternum is affected, the abscess usually forms over the front of the bone; when, however, the disease affects the lateral or posterior surface of the bone, the abscess passes forwards between the costal cartilages immediately to one side of the sternum. When a sinus is met with in this position, the posterior surface of the sternum must always be examined.

TREATMENT.—Of tuberculous osteitis of the ribs.—When the disease can be completely removed, the result is very satisfactory. Incomplete methods of treatment—such as opening the abscess and scraping the bone—are of little value, and, although healing may occur in some cases, the results do not compare with those of the radical method which we advise. Occasionally, the abscess heals after opening it, scraping out the lining membrane, injecting iodoform and glycerine, and stitching up the wound (see Vol. I. p. 235), but it is not a method of treatment that we recommend.

The best plan is to excise the abscess completely along with the affected area of the rib, and this is comparatively easily done if the abscess is not large. The swelling is exposed by raising a suitable flap, and the wall of the abscess is carefully isolated from the surrounding soft parts without opening it until the area of bone from which it springs has been clearly defined. It is often found that, when the soft parts have been separated, it is possible to lift the abscess wall off the rib for some little distance, and that the area of bone from which it takes its origin is comparatively limited.

The next step is to divide the periosteum at right angles to the long axis of the rib in front of and behind the limits of the abscess; the periosteum is peeled back with a rugine all round the rib; the rugine is left in place behind the rib so as to guard the pleura, and the rib is divided with cutting-pliers beyond the abscess on both sides. It may then be possible to lift out the affected portion of the rib together with the unopened abscess, but usually the pus extends behind the

rib and the abscess will be opened at this point. If this is the case, the pus is rapidly flushed out of the wound, the external portion of the abscess wall is clipped away, and then the affected portion of the rib can be lifted out so as to expose the periosteum on its inner surface. This is not infrequently covered with tuberculous granulations which should be scraped away, taking care not to perforate the pleura, and finally the surface left may be rubbed with undiluted carbolic acid so as to destroy any bacilli that may have been left behind. A clean wound, probably without any tuberculous material in it, is thus left and is now stitched up; if, however, undiluted carbolic acid has been applied to the surface it is well to put in a small drainage tube at one angle of the wound for two or three days. Healing usually occurs by first intention, and the patient is well in about ten days.

Of tuberculosis of the costal cartilages and sternum.—Here the principles of treatment are the same, but the operation is more difficult. The abscess is dissected away and the costal cartilage is divided outside its limits and also disarticulated from the sternum. If the latter bone is affected, a rugine is introduced behind it, the soft parts are gently pushed back, and as much of the side and posterior surface of the bone as is affected is clipped away with cutting-forceps until the whole of the diseased area has apparently been removed. The deeper structures are then carefully scraped, and sponged over with pure carbolic acid, and it is generally well to leave the wound open and pack it with iodoformed gauze until the surface is covered with healthy granulations, when the packing should be discontinued.

When the sternum itself is the seat of disease, the treatment is similar. The abscess is isolated as far as possible, the whole of its anterior wall is clipped away, and the carious surface of the sternum is exposed and gouged or chiselled away well wide of the disease. If the whole thickness of the bone is diseased, the sternum should be gradually bored through and enough bone cut away to get beyond the disease. The wound is packed and allowed to granulate from the bottom.

When the patient comes under notice with a *tuberculous sinus*, due to any of these causes, the treatment is similar. The sinus is thoroughly opened up, dissected out if possible, and the diseased rib or portion of the sternum is removed. After the soft tissues have been scraped and undiluted carbolic acid has been applied to them, the wound is left open and packed with iodoformed gauze.

INFLAMMATION OF THE PLEURA.

Two forms of inflammation occur in the pleural cavity—namely, non-suppurative inflammation of the pleura, or pleurisy, and the suppurative form, commonly known as empyema.

NON-SUPPURATIVE INFLAMMATION OF THE PLEURA.

Pleurisy is essentially a medical disease, and the only point that we have to consider is the treatment of pleurisy with effusion. It may be mentioned that the majority of the cases of pleurisy with effusion occur in adults and that they seldom call for surgical interference.

TREATMENT.—When surgical interference is required, it is for the relief of dyspnœa or other symptoms of intra-thoracic pressure, or because the fluid does not become absorbed; it takes the form of paracentesis thoracis. It is essential to avoid free opening of the pleural cavity, especially when the case is tuberculous.

Exploratory puncture of the thorax.—By this means the diagnosis of pleural effusion is confirmed, and the nature of the fluid determined. The operation is simple, but it is important to use a sufficiently large and long needle. In a moderately stout person the normal pleural cavity may lie at least an inch and a half from the surface of the skin, and this measurement may be much increased if the pleura is thickened. Hence, the needle should be three inches long and should be of large calibre, otherwise it is apt to become blocked by flakes of lymph and there will be difficulty in drawing off the fluid. The syringe should be provided with a well-fitting piston so that sufficient suction may be produced. The ordinary hypodermic needle and syringe are of little value. It is always advisable to employ a syringe and needle that can be boiled. It is also well to be provided with an ordinary aspirator and an aspirating-bottle, so that, if necessary, the whole of the fluid may be withdrawn at the same time. The greatest care must be taken in disinfecting the skin and the instruments, as it is not infrequent for suppuration to follow exploration of a case of simple pleurisy with effusion. Carbolic acid should not be used to disinfect the needle or barrel of the syringe, because it causes coagulation of the fluid and a cloudy appearance which may be mistaken for pus. If it is not possible to boil the syringe, and carbolic acid must be used to disinfect it, it should be thoroughly washed out with boiled water before use.

When the effusion is not localised to a particular area of the pleura, the patient should be placed in the recumbent or semi-recumbent position with the affected side well over the edge of the bed or couch; an aseptic towel should be placed beneath the thorax, the skin disinfected, and the needle introduced through the sixth intercostal space in the mid-axillary line. If a large needle is employed, it is well to make a small puncture through the skin with a tenotome in the first instance, as this not only allows the needle to pass in more readily, but avoids the risk of carrying in epidermis and bacteria from the cutaneous surface. No anæsthetic is necessary, but in a nervous patient a few drops of a 2 per cent. solution of novocaine may be injected hypodermically; freezing should be avoided, as the skin becomes hard and it is difficult to introduce the

needle. The left forefinger and thumb are used to steady the parts over the intercostal space as the needle is introduced, and the latter is inserted by a single sharp thrust immediately above the upper border of the lower rib, the depth to which it is to go being fixed beforehand by placing the forefinger upon it at a suitable distance from the point. If care is taken to avoid striking the rib in doing this, the introduction of the needle causes only trifling pain. The exhausting-syringe is then attached and some fluid is withdrawn. Should it not be purulent or, if purulent, should the symptoms not be urgent, it is well to submit the fluid to bacteriological examination before doing anything more, as this may have an important bearing on treatment.

Paracentesis thoracis.—When it is necessary to evacuate the fluid from the chest, this should be done by simple paracentesis if the fluid is serous; if it is purulent, however, this is rarely sufficient. It is true that in the early stages of pneumococcal empyema, when the fluid is just becoming purulent, its removal by paracentesis may suffice for a cure, but free evacuation and drainage are required in the majority of cases. Paracentesis may, however, be of use in affording temporary relief when, for any reason, the surgeon is not prepared to undertake incision and drainage immediately, and it may also be useful when there is pus in both pleural cavities, and the surgeon decides to incise and drain one side at a time, the other being aspirated sufficiently to relieve the urgent pressure symptoms.

The site of the operation is similar to that for exploratory puncture (*vide supra*), and the ordinary aspirator with an evacuating-bottle should be used. A canula of fairly large calibre is employed, and it is essential that the point of the trochar should be sharp; it is usually well, in nervous patients, to inject novocaine before puncturing the skin. As soon as the canula is in, the trochar is withdrawn and the bottle is attached. It is important not to keep the vacuum in the bottle too high, otherwise the rush of fluid may dislodge masses of lymph which may block the needle, or the lung may be sucked against the point and either plug it or be punctured and bleed freely. The best plan is to keep the exhaustion at such a point that the fluid runs steadily and fairly slowly, and this allows the intra-thoracic organs to accommodate themselves to the altered conditions. If the flow becomes arrested, it will probably be due to lymph blocking the orifice of the canula, and a plunger several sizes smaller than the canula should be passed down the latter so as to dislodge the lymph. The reason for using a small plunger is that it can not only be used to push the mass of lymph away but also may be left *in situ*, so as to keep the lymph from falling back over the orifice of the tube, as it would very probably do were a plunger used which fitted the canula closely, and which therefore must be removed before the flow could be re-established.

Paracentesis must be discontinued if the patient should faint or if

there should be persistent cough or hæmoptysis. It is also well to desist—for a time, at any rate—if the fluid becomes blood-stained. When it is unnecessary to withdraw the whole of the fluid, the aspiration need only be carried to the point at which the flow becomes scanty and intermittent and the pressure symptoms are relieved. After enough fluid has been withdrawn, the aspirator is detached from the canula, the thumb is placed over the end of the latter, the tissues are pinched up around its shaft, and the canula is withdrawn. The small puncture is sealed by collodion dressing.

SUPPURATIVE INFLAMMATION OR EMPYEMA.

This is a common affection; its precise characters depend largely upon the nature of the bacteria causing the suppuration. A variety of these organisms have been found in suppurative pleural effusions. In children, the most common is the pneumococcus, in adults, the streptococcus, but combinations of the two are also met with. Occasionally, the infection is staphylococcic; sometimes putrefactive organisms are present, especially when the condition is associated with gangrene of the lung. The tubercle bacillus is found in a considerable number of instances. The latter cases are chronic, and are considered separately.

The *symptoms* and diagnosis of purulent pleural effusions lie essentially within the province of the physician. The symptoms at the onset may be severe and characterised by rigors, sweats, emaciation, increasing anæmia, hectic temperature, and the typical physical signs of fluid in the chest. The symptoms will continue unless the pus is evacuated, and may be accompanied by signs of severe pressure. The inflammation of the pleura will also persist and give rise to increasing thickening, so that before long the lung becomes so bound down to the thoracic wall, especially in the vertebral groove, that even after removal of the fluid there is no likelihood of its expansion. From this point of view alone it is essential that the pus should be evacuated as soon as possible, because if the lung fails to expand; the only way in which healing of the cavity can take place is by falling-in of the chest wall, and this is a very slow and imperfect process.

Acute purulent effusions are rarely absorbed spontaneously, although it is said that this occasionally occurs in those due to the pneumococcus. If the condition is allowed to persist unrelieved and the patient lives, the pus finds its way through the thoracic wall; it may point anywhere, but the most common place is in the fifth interspace in front, just external to the margin of the pectoralis major. Occasionally, it finds its way into the bronchi; and is discharged through the air-passages.

The pus is not usually diffused throughout the whole pleural cavity. This may occur; however; when septic material has been introduced into a healthy pleura and in cases in which rapid inflammation and

suppuration take place, for example after puncture of purulent lung-cavities or rupture of a sub-diaphragmatic abscess through the pleura. Generally; however; the lung becomes adherent to the parietal pleura over considerable areas; and in the majority of cases the pus accumulates over the lower lobe of the lung, and the surfaces of the pleura become adherent above the purulent collection, so that the upper part of the pleural cavity remains healthy and unadherent, and in that situation the lung expands satisfactorily. Most empyemata are circumscribed, but frequently the whole of the lower part of the thorax is converted into a suppurating cavity.

In other cases the collection may be much smaller in extent, and may take the form of a typical localised empyema. According to Godlee; there are three forms of localised empyema: (1) that in which the pus is contained in a cavity between the outer surface of the lung and the costal pleura; (2) that in which the pus lies between the diaphragm and the base of the lung; and (3) that in which it is situated in the fissure between two contiguous lobes, or between the lung and the mediastinum. The exact locality of the pus is determined partly by physical signs and partly by puncturing with an exploring-needle, and in some cases it may be a matter of chance whether the pus is hit or not; it is especially difficult to localise the abscess when it lies between the lung and the mediastinum. A radiogram may be of considerable assistance.

TREATMENT.—There is no question that in acute cases the sooner the fluid is evacuated the better, and this must be done by free incision and not by paracentesis; the case in fact should be looked upon as an abscess, and treated accordingly.

Of non-localised empyema.—In operating upon an empyema, the first question is as to the anæsthetic. Chloroform should be given in preference to ether, as the latter may cause violent coughing, and great accumulation of mucus in the tubes which diminishes the already insufficient breathing capacity. The pressure symptoms may be so severe that it is inadvisable to administer a general anæsthetic at all, and under these circumstances local anæsthesia by Schleich's infiltration method (see Vol I. p. 485) should be employed. A simpler solution of the difficulty in bad cases, however, is to have recourse to simple paracentesis thoracis first, in order to relieve the severe pressure symptoms, and then to incise and drain the pleural cavity a day or two later when the patient has recovered from the embarrassment to the breathing.

The position of the patient is determined to a large extent by the spot at which the incision is to be made, which must be where the exploring-needle showed the pus to be situated. When the incision is to be in the sixth or seventh space in the mid-axillary line—which is the point chosen when there is a large collection in the lower part of the chest—the patient should lie flat upon the table or bed, being drawn well to the edge; the surgeon can then work sitting down and facing that side of the thorax.

If, however, the incision is to be made in the ninth space just external to the angle of the scapula—which is the most dependent point when drainage is likely to be wanted for some time, and is also the lowest point at which the pleural cavity is most certain to be opened without danger of the track becoming too oblique from the upward protrusion of the diaphragm—it will be necessary to turn the patient over on to the affected side. The patient should not be turned on to the sound side unless in exceptional cases, otherwise the respiration may be seriously hampered.

The operation must be conducted aseptically because, although bacteria are present in the abscess cavity, it is essential not to introduce fresh ones from without. Those in the pleura have probably largely lost their virulence, and experience shows that with free drainage they quickly die out. This is especially important in pneumococcal cases and in those due to the tubercle bacillus; in the latter, the addition of sepsis greatly diminishes the chances of cure.

Much discussion has taken place as to whether the opening should be made through the intercostal space or whether a portion of rib should be removed as well. In favour of opening up the intercostal space it is urged that in many cases there is quite enough room, especially when the chest is bulging, and that, although removal of a rib may be of temporary advantage, it does not really give rise to more perfect drainage, because new bone rapidly forms and the opening becomes small. This is quite true in many cases in children when the periosteum of the rib is not taken away also; but by resecting a portion of the rib, a much better opening is obtained for the immediate purposes of the operation, because the surgeon can introduce his finger into the pleural cavity and explore it thoroughly, and, moreover, in many cases—especially those of pneumococcal origin—the period required for drainage is so short that the question of regeneration of the rib is of no importance. On the other hand, in cases due to streptococcal infection, or in those in which the drainage is likely to be prolonged, regeneration may be prevented by clipping away the periosteum after the rib has been removed. The permanent loss of a portion of the rib seems to be of no consequence whatever to the patient, and inflammation and necrosis of the ends of the bones exposed to the action of the pus is rare. We advise, therefore, that a portion of the rib should always be resected. The operation is generally done just as quickly—and in some cases more quickly, as there is less trouble with the bleeding—while the immediate investigation and clearing out of the cavity are much more satisfactorily accomplished.

After the surgeon has settled which rib to resect, the skin is steadied and put upon the stretch by the forefinger and thumb placed above and below that portion of the rib, and the knife is carried right down to the outer surface of the bone along its centre and parallel to its long axis,

dividing all the soft structures and periosteum in one cut for a distance of one and a half to two inches. The knife may then be carried along the incision a second time to make sure that the periosteum is completely divided throughout, and then the latter is rapidly peeled off the outer surface of the rib. A curved rugine is then insinuated around its upper border, taking great care not to puncture the pleural cavity. The instrument is made to work from the upper border to the lower, and when it emerges around this, it is pushed backwards and forwards along the rib, between the periosteum and the bone, and so bares the inner surface of the whole of the portion of the rib to be removed. The rugine is then pushed to one end of the incision and held in position so as to keep back and protect the pleura, whilst the rib is nipped across from the upper to the lower border with a pair of cutting-pliers. The rugine is then slipped up to the opposite end of the incision and the bone is divided there in a similar manner; this procedure is facilitated by lifting up the end of the bone first divided and steadying it with a pair of sequestrum forceps. At least an inch and a quarter of bone should be removed. When the resected portion of the rib has been taken away, the periosteum with the parietal pleura covering it is exposed between the divided ends of the rib, and in the centre of this space a pair of sinus forceps is pushed in until the pus is reached. The blades of the forceps are expanded very slightly at first so as to allow the pus to escape quite slowly. It is not advisable to make a free incision at once, otherwise the pus gushes out and there may be syncope from the sudden relief of pressure.

After the pressure has been thus gradually relieved, and the pus simply ebbs and flows with respiration, the periosteum and pleura may be clipped away to an extent corresponding to the space between the divided ends of the bones, so as to avoid subsequent bony formation, the intercostal vessels being clamped and tied as they are divided; this gives an opening large enough for the finger to be introduced into the cavity. It is most important that the condition of the pleural cavity should be investigated with the finger, as it is not uncommon to find large fibrinous masses which plug the opening and prevent the escape of pus, and which therefore must be cleared out before the pus will flow freely; if left in the thoracic cavity they will no doubt break down and escape in fragments, but they will probably delay the closure of the wound. As a rule, these masses can be brought to the surface with the finger, seized with forceps and pulled out, or they can be hooked out with a small spoon or curved blunt instrument. Some surgeons advocate washing out empyemata, but we do not recommend this. Immediate death has followed this practice, for reasons which are not clear, and we have found that washing out a cavity does not get rid of these masses any better than can be done with the fingers or forceps, aided by the expulsive action of the thorax when the child coughs. If irrigation is

employed—and it should only be done when the masses of lymph cannot be otherwise removed—saline solution should be used at a low pressure, and care taken to ensure a free exit for the liquid and the masses of lymph. Digital investigation of the interior of the pleura may also give important information as to the condition of the lungs.

The rapidity of escape of the pus is regulated by the finger in the opening into the chest, and it is essential to try to get as much expansion of the lung as possible at the time of the operation. This is done by allowing the patient to awake partially from the anæsthetic, and then exciting coughing by rubbing the parietal pleura with the finger in the cavity. Every time coughing occurs, air is forced into the lung and leads to its expansion. At the moment the child coughs, the finger is slightly withdrawn from the opening, and a little pus is allowed to escape, and then the finger is pushed in again and plugs the opening during inspiration. This prevents air getting back into the pleural cavity, and the lung may often be made to expand completely in this way.¹ If the lung expands fully at the time of the operation and the case is pneumococcal in origin, a short drainage tube just projecting into the pleural cavity will be sufficient.

A simple way of ascertaining the correct length of the drainage tube is to bend the tip of a probe at right angles, pass it into the pleural cavity, and draw it back until the point catches against the inner surface of the thoracic wall. The thickness of the thoracic wall from the skin to the parietal pleura is thus ascertained, and a drainage tube a quarter of an inch longer than this will suffice. No lateral holes should be made in the tube, but it is important to cut a semicircle out of one side of its inner end so as to prevent it being blocked when the lung comes against it in expanding. Many special drainage tubes have been introduced, and some form provided with a shield to prevent the tube from slipping into the chest is advisable when prolonged drainage is necessary; in the first instance, however, all that is required is to cut the tube flush with the skin and secure it to the latter by silkworm-gut stitches, or to pass a safety-pin through the outer end of the tube to prevent it from slipping into the chest.

After-treatment.—The discharge is usually free for a few days, and the dressings will require changing twice daily. As the discharge diminishes, the dressings will be changed less frequently; the case is in fact treated like an ordinary abscess. The stitches fastening in the drainage tube may be removed about the third day, and if further drainage is necessary a tube, provided either with a flange or with a safety-pin run across it to prevent it slipping into the thorax, should be substituted; the pressure of the dressings outside will prevent the tube slipping out. Irrigation should not be employed, as it is not only useless for the reasons

¹ If the operation is performed under differential pressure, these manipulations are not required.

mentioned in speaking of acute abscess, but sudden death and serious collapse have been known to occur from it.

The length of time that the drainage tube should be continued depends largely upon the bacteriology of the case. In pneumococcal cases in children, in which there is no great fixation of the lung, the drainage tube can often be left out about the fourth day and in any case as soon as the discharge becomes serous; even if distension of the pleura were to take place again, the discharge, being serous, might become absorbed. Godlee suggests that, under these circumstances, a grooved instrument should be introduced every two or three days to prevent granulations blocking the opening and allow the escape of any serum that has collected; if this is done, the closure of the cavity is facilitated. Should the fluid thus escaping be purulent, the tube should be reintroduced. The management of the tube is one of the most important points in the treatment of these cases; it is essential to maintain strict asepsis. In streptococcal cases drainage must as a rule be carried on much longer than in those due to the pneumococcus.

The patient should be kept in bed for a week at least, but if at the end of that time the temperature is normal and the local condition has improved, he may be allowed to sit up and get about; drainage will be more efficient when he is in the erect position. Means should be employed to aid the expansion of the lung, and therefore the patient should not lie always on the sound side, and breathing exercises should be practised. Children should have whistles and similar toys to blow into. Suitable general treatment must be employed, and the patient should go to the seaside or the country if healing is not progressing rapidly enough, provided that he can obtain proper aseptic treatment.

Of localised empyema.—The treatment in the localised cases should follow similar lines, but the great difficulty is to find the pus when the collection is small, as the physical signs may be so indefinite that the surgeon may only find the abscess after repeated punctures. When, however, the pus has been found, the needle is left in as a guide, and a portion of the rib above or below it is resected and the empyema evacuated. These cases are usually more favourable in their prognosis because the lung is not bound down to any great extent; indeed, it is frequently adherent to the parietes.

Of double empyema.—This is a very serious condition, as the respiration on both sides is embarrassed, and it is not safe to open both pleural cavities simultaneously for fear of causing still further trouble by the production of a double penumo-thorax. The best plan is to open one side and aspirate the other for the time being, the opening of the second side being delayed until the patient has become accustomed to the new condition of affairs. If the respiration is very embarrassed, some of the pus may be drawn off from both sides by an aspirator,

and next day one side may be opened, the other side being dealt with later.

Of an empyema that has ruptured into a bronchus.—In these cases it is probably best to wait and see if the cavity is effectually evacuated through the bronchial tubes or not. Should the evacuation not be satisfactory, the empyema must be opened from the outside and drained, but under these circumstances closure of the wound is often very long delayed, and sometimes a bronchial fistula remains. The patient is, however, saved from the dangers associated with the continuous discharge of pus through the bronchi, and usually only a small sinus is left.

Of an empyema that has failed to heal.—The length of time that an empyema takes to close after incision and drainage varies greatly, the chief determining point being the expansion of the lung. When this is incomplete, a cavity is left which takes a long time to close, but closure eventually does occur in most cases, falling-in of the chest wall and displacement of the various intra-thoracic structures taking place as the result of the contraction of the granulation tissue lining the cavity.

In some cases, however, the lung is so bound down that a large cavity or a long sinus remains, and the surgeon is confronted with a serious state of affairs. This condition is most likely to occur when the empyema had existed for some time before the pleura was incised and drained. Another cause of a sinus after an empyema is the presence of tuberculosis, which interferes with healing, especially if it is complicated with sepsis. Among the minor causes of failure are imperfect drainage, such as occurs when the opening is too high up in the chest. Again, if a portion of the rib has undergone necrosis, a discharging sinus will remain, but here the pleural cavity may close and the sinus may be merely an external one. Another cause of the persistence of the sinus—and not a very infrequent one—is that the tube has been allowed to fall into the cavity and is retained there. A radiogram will generally reveal its whereabouts if this is the case.

The chief factors in the non-closure of an empyema are therefore imperfect expansion of the lung, imperfect drainage, or a tuberculous condition of the pleura. When an empyema has lasted for a long time, amyloid degeneration of the viscera may take place as the result of the continued septic absorption, and the patients gradually go downhill and ultimately die from exhaustion; hence, when it is evident that closure of the cavity is not likely to occur, it is highly important to take steps to promote it.

In any case of empyema which has lasted for more than six or eight weeks and in which a cavity remains, the surgeon should first make sure that the delay is not due to imperfect drainage. If the opening has been originally made in the mid-axillary line; and if it is found that a probe

passed into the cavity goes down to a lower spot where pus can collect; a counter-opening should be made in that situation. The original opening should be dilated; and a drainage tube perforated laterally in a number of places should be passed from one opening to the other. This may be stitched to the skin at both openings; but after about five days; the sutures should be cut and the tube withdrawn, cleaned; and inserted. When the tube is withdrawn for cleaning, it is well to attach a long piece of silk to one end of it and then to withdraw it by the other end; the silk thread is drawn through the sinus; and serves to pull the tube back in position after it has been cleansed. The tube may be shortened in about a week or ten days; the upper end being cut so that it no longer projects through the upper aperture.

If this treatment is unsuccessful, a vaccine prepared from the organism present may be tried, but is seldom of much value. A better plan is to inject the sinus from time to time with bismuth made into a thick paste with paraffin and vaseline in such proportions that it is solid at the body temperature (see Vol. II. p. 458). Occasionally; one injection may cause the sinus to heal; more often several injections at intervals of about a week will be required. The position, size; and ramifications of the sinus may be determined, and the progress of the cases ascertained from time to time, by means of radiograms. This method is not, however, always successful.

The cases in which there is imperfect expansion of the lung are much more troublesome. Here a cavity is left and, after the diaphragm and other soft structures have yielded as far as possible, the only possible mode of closure of the cavity is by the falling-in of the thoracic wall. This is an extremely slow and generally an imperfect process, and in the meantime the patient gradually goes downhill from the continued sepsis. If, therefore, closure has not occurred in six months in spite of perfect drainage and good hygienic conditions, some operative interference must be undertaken. There are two operations at the disposal of the surgeon: namely, thoracoplasty, or Estländer's operation, in which the portions of the ribs forming the outer wall of the cavity are removed, and decortication, in which the thickened pleura—or at any rate, the dense fibrous outer layer of it—is peeled off the lung so as to allow the latter to expand. The operation in common use at present is that of thoracoplasty; this is often severe and difficult and does not always succeed, but it is absolutely necessary when a prolonged trial of other methods has failed; it is also required when the case is due to tuberculosis.

Thoracoplasty.—This operation should be done under intra-tracheal anaesthesia or differential pressure (see p. 232), and with the aid of a radiogram taken after injection of bismuth cream (see Vol. II. p. 458). The first step is to open up the sinus, insert the finger, and ascertain exactly the limits of the cavity left. These are marked out on the chest wall, and

the portions of the ribs lying in the space thus marked out must be removed. If the cavity is small, only two or three ribs need be taken away, but with large cavities portions of several ribs must be removed. The method of exposing the ribs will depend upon circumstances, but as a rule it is best done by a flap which is so marked out as to expose the whole extent of the cavity. No precise rules can be given for the formation of this flap as it must depend on the conditions present. Probably the flap that will least interfere with the muscles will be one with its convexity forwards and downwards. The flap must be larger than the cavity beneath it so as to give plenty of room, and it should take everything off the thoracic wall except the intercostal muscles. When the flap is raised, the bleeding points should be secured before going further.

The finger is now introduced into the cavity, and the exact extent of each rib that requires removal is ascertained; the amount of each rib requiring resection depends upon the size of the cavity beneath. The periosteum over each is then incised and separated from the rib, and the desired portion taken away (see p. 221). In bad cases the upper ribs must be resected, but it is never advisable to remove any portion of the first rib, and it is doubtful whether removal of the second is necessary; the required amount of all the other ribs should be excised without hesitation. The patient's condition may be so bad that it may not be safe to remove all the necessary ribs at one operation, and in this case it will be better to attempt to obtain closure of one part of the cavity and to leave the remainder for a second operation.

After the necessary portions of rib have been removed sub-periosteally, the whole of the periosteum and thickened pleura forming the outer wall of the cavity should be cut away with scissors in one piece. The incision should commence posteriorly, and the intercostal vessels are caught as they are divided; there is generally very little hæmorrhage, as the intercostal vessels are largely obliterated by the great thickening, present. In any case, there is no difficulty in arresting the bleeding as there is plenty of room to seize the vessels, provided that the ribs be excised sub-periosteally and separately before the pleura is removed.

The removal of the pleura and periosteum leaves a cavity, the floor of which is formed by the thickened pleura covering the collapsed lung. This cavity is now cleaned as thoroughly as possible and, if thought desirable, the granulation tissue lining it is scraped away with a sharp spoon, although this is not essential. Decortication of the lung (see p. 228) may now be carried out if desired; but this is not an essential part of Estländer's operation, the object of which is to allow the soft parts to fall in and come into contact with the collapsed lung rather than to promote the expansion of that organ.

The flap of soft parts is now laid back in position, and if a sufficient amount of the thoracic parietes has been taken away, the flap will come

into contact with the visceral pleura everywhere. It is well, however, to insert drainage tubes beneath the flap.

The results of this operation are extremely variable. In the case of small cavities which do not extend high up the chest, the success may be striking; in others, even the most extensive operation fails to cure. Considerable improvement, however, generally occurs, for the main part of the cavity becomes obliterated and only a comparatively small sinus is left—usually at the upper part—and from this only a slight amount of discharge comes, which may not do the patient any harm.

Decortication.—In view of the unsatisfactory results that sometimes follow Estländer's operation when performed for bad cases, the suggestion has been made that the lung should be decorticated—that is to say, that the dense, fibrous layer of the pleura which covers it and binds it down into the vertebral groove should be peeled off so as to allow the lung to expand. We have followed this recommendation with success in more than one case in which a previous Estländer's operation had failed, but there is a danger of setting up a septic infection of the lung tissue.

The steps of the operation are almost identical with those of thoracoplasty in the early stages—and indeed decortication may be looked upon merely as an addition to that operation.

After the cavity has been exposed by the removal of the thoracic parietes, the dense layer of the visceral pleura covering the lung is divided with the knife until the lung is reached; the edge of the incision is then seized in forceps and the thickened pleura stripped off the lung with a blunt instrument as far back as the edge of the vertebral groove. It is striking to see how the lung expands when this has been done. As a rule, the oozing is only moderate. It is advisable that the separation of the visceral pleura should be effected slowly, as collapse of the lung, which was previously prevented by the dense adhesions, may occur and result in serious embarrassment to respiration. Some form of differential pressure (see p. 232) should be used in these cases to prevent this complication. The operation is finished by putting in a drainage tube and suturing the cutaneous flap as before.

Of tuberculous empyema.—The symptoms associated with tuberculous empyema are indefinite, and the condition may only be discovered when the physician comes to examine the chest; it may occur with or without pneumo-thorax. In the former case there will probably be an acute onset corresponding to the perforation of a cavity into the pleura; but when no such perforation occurs, the symptoms may be quite slight and few or no pressure symptoms may be present; the patient simply goes about with a collection of fluid in the chest which, however, although not under great pressure, leads to collapse of the lung.

These cases are very unsatisfactory. As a matter of experience, it

is found that evacuation and drainage does not usually lead to healing; the lung fails to expand, the chest takes a long time to fall in, and even with the greatest care, sepsis is prone to occur, and then, in addition to the tuberculous empyema; the patient will suffer from a septic cavity and will go downhill rapidly. Hence; if the empyema is tuberculous and not septic, it is better to avoid anything like a free incision; indeed; in cases without marked pressure symptoms it may be inadvisable to interfere at all, and, if anything must be done, it should take the form of occasional partial aspiration rather than free opening. The greatest care must be taken with the aseptic management of the case, lest a simple tuberculous empyema be transformed into a septic one.

PYO-PNEUMO-THORAX.

Cases of simple pneumo-thorax are not uncommon after injury, and are dealt with separately (see p. 209); this condition may, however, be followed by suppuration, when a septic pyo-pneumo-thorax occurs. Most cases of pyo-pneumo-thorax, however; are due to the perforation of a tuberculous cavity, with the free passage of air from the bronchus into the pleural cavity, followed by suppuration. Cases of tuberculous pyo-pneumo-thorax; in which the ordinary pyogenic bacteria are absent, may however occur, and they are then very chronic and do not cause severe symptoms.

TREATMENT.—When the condition is septic, the pleural cavity must be opened and the treatment conducted on the lines laid down for empyema. When; however; it is tuberculous without any septic complication, it is better not to operate, as the results of incision are bad and the improvement is only temporary. If these cases are drained it is very difficult to prevent the entrance of septic organisms; and if this occurs, the patient rapidly goes downhill. There is practically no chance of the lung expanding sufficiently to fill the cavity; and the patient's condition is generally so bad that any operation such as Estländer's is inadvisable.

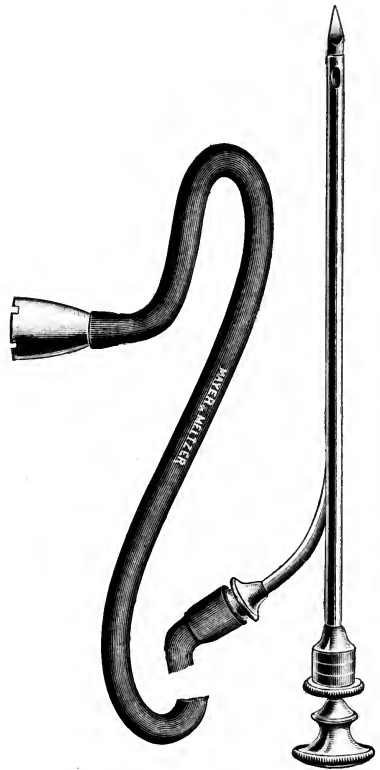


FIG. 56.—GODLEE'S NEEDLE FOR SIPHON DRAINAGE OF THE PLEURAL CAVITY.

If, however, the pressure symptoms are severe, the chest should be aspirated from time to time. Should this fail to produce amelioration, Godlee suggests the employment of syphoning, and describes the following plan:—

The patient is placed on his back with his side projecting slightly beyond the edge of the bed, and two needles (see Fig. 56) are introduced into the chest about the eight or ninth interspace—one towards the anterior and the other towards the posterior part of the chest. It should be ascertained that the lung is not adherent at the points selected for the introduction of the needles. An india-rubber tube is attached to each needle; that in connection with the anterior one is filled with boric lotion and passes to the bottom of a large bottle containing warm boric lotion, while an aspirator is connected with the other, or the tube attached to it is simply allowed to fall into a basin which is placed on the floor and which contains enough boric lotion to cover the end of the tube. The fluid is then allowed to drain from the chest, and its place is taken by the boric acid lotion. When the lotion comes through quite clear, the anterior tube is removed, as much as possible of the boric lotion evacuated by an aspirator attached to the posterior tube, and the wound closed. This procedure may be repeated if necessary.

SEPTIC MEDIASTINITIS.

When a penetrating wound of the mediastinum does not lead to immediate death from hæmorrhage, it may be followed by septic inflammation and diffuse cellulitis or the formation of an abscess in the mediastinum. Septic mediastinitis may also follow septic inflammation in the neck—such as Ludwig's angina, or tracheotomy, or operations upon the thyroid or cervical glands in which sepsis has occurred; it is not infrequent in connection with the impaction of foreign bodies in the œsophagus if perforation takes place, and it may occur occasionally as a primary disease in cases of general sepsis. Chronic abscess in the anterior mediastinum is not uncommon in connection with tuberculous disease of the sternum or costal cartilages, and occasionally with a similar affection of the mediastinal glands; chronic abscess in the posterior mediastinum is also common in disease of the dorsal vertebræ.

In acute cases there is great pain, severe cough, high fever, dyspnœa, and all the other symptoms of septic inflammation. *In chronic cases* the symptoms are less severe and are difficult to distinguish from those of tumour of the mediastinum; there may be dysphagia, dyspnœa, occasional asthmatic attacks, lividity, and irregularity of the cardiac rhythm. If the patient survives—and this is especially the case in chronic abscess—the pus may find its way outwards at the side of the

sternum and point between the costal cartilages ; in cases of chronic abscess in the posterior mediastinum, it passes backwards between the ribs forming a dorsal abscess, upwards into the posterior triangle of the neck, or downwards behind the diaphragm. In other cases the abscess may open into the bronchi and the pus may be expectorated, or it may perforate the pleura and set up a pyo-thorax ; sometimes it invades the pericardium and gives rise to suppurative pericarditis.

The *prognosis* is very serious, and the chances of recovery are very slight in acute mediastinal suppuration, the patient dying of pyæmia or perforation of the pericardium or pleura, if he does not die of acute septicæmia or of the pressure effects. In chronic cases, however, the abscess frequently finds its way externally, and, if it is opened, the symptoms will be relieved.

TREATMENT.—This is a matter of extreme difficulty. If a collection of pus in the anterior mediastinum can be accurately diagnosed, it may be possible to get at it by trephining the sternum and enlarging the opening so as to tap the abscess and provide for drainage ; this has been done successfully in a few cases. Should an abscess occur in the posterior mediastinum in connection with perforation of the œsophagus by a foreign body, the abscess may be reached from behind by the operation described in Vol. IV. p. 169. The treatment of a tuberculous abscess is conducted on lines similar to those for tuberculous abscesses elsewhere.

CHAPTER XIX.

OPERATIONS ON THE LUNGS UNDER DIFFERENTIAL PRESSURE.

RECENTLY, the surgery of the thorax has been greatly advanced and altered by the introduction of what are called the 'differential pressure' methods. These are based on the fact that the thorax in the normal state acts under negative pressure, but that when it is opened the air passing in from outside produces a condition of equilibrium, the elastic tissue of the lung contracts, the lung collapses, and no expansion takes place on inspiration. Hence it is a very serious matter to open the pleural cavity on one side, and practically fatal to open both sides. The 'differential pressure' methods aim at preventing this collapse of the lung and at enabling the surgeon to open one or even both pleural cavities without a fatal result.

There are two chief methods by which the occurrence of collapse of the lung on opening a healthy chest may be prevented. The first is the 'negative pressure' method, which consists in taking steps to maintain a negative pressure around the thorax after the chest has been opened; this is the plan of which Sauerbruch is the chief exponent. The other is the 'positive pressure' method, which has been especially worked out by Brauer, in which the pressure of the air within the lungs is increased, so as to prevent their collapse when the ordinary atmospheric air is admitted into the thorax from without.

NEGATIVE PRESSURE METHODS.

The method by which negative pressure is obtained is by the construction of a chamber around the body of the patient in which the atmospheric pressure can be diminished, while the head is not included in the chamber, and therefore the air in the lung is under the ordinary pressure. This chamber must be large enough to allow room for the operator and his assistant, and the smaller ones must have a smaller

chamber for entrance and exit without altering the pressure. The patient's head and neck pass through an opening at one end of the chamber, and are shut off by an elastic india-rubber collar round the neck. The general arrangement is evident from Fig. 57, which shows a convenient portable chamber. One difficulty in Sauerbruch's chamber is that of communicating with the anæsthetist, which in the early model was done by means of a telephone. Lately, a piece of balloon-silk has been inserted near the head end of the chamber, through which the operator's voice can be distinctly heard. Willy Meyer of New York has converted the operating-theatre itself into a negative pressure chamber, the patient's

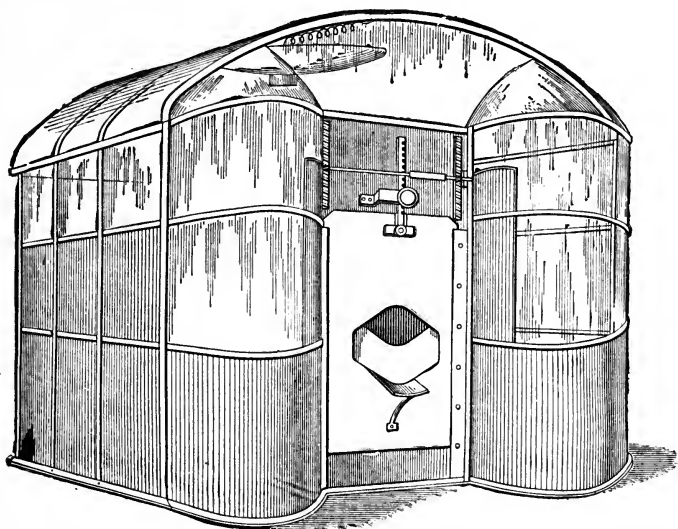


FIG. 57.—SAUERBRUCH'S NEGATIVE PRESSURE CHAMBER. This is the recent model, and is portable. It is fitted with india-rubber flanges below, so that it adheres to the floor when the air inside is being exhausted. The patient's head projects through the opening shown, and rests on the head-rest. Lighting and ventilation are provided for. The convex ends are to allow the surgeon and his assistants sufficient elbow-room. (Garré and Quincke, *The Surgery of the Lung*.)

head being passed through an opening in the wall into a second chamber of smaller size, which may if necessary be converted into a positive pressure chamber, so that either plan can be adopted according to the requirements of the operator (see Fig. 58).

The reduction in pressure should in no case exceed 10 mm. to 12 mm. of mercury; when the chest is first opened, the difference ought not to be so great. Usually, about 3 mm. to 5 mm. of mercury is sufficient until the patient becomes accustomed to it; the pressure may then be reduced to 7 mm. to 9 mm. which is the normal pressure employed. The negative pressure embarrasses the right side of the heart to a certain extent, and therefore if the heart is weak or if there is emphysema, the pressure

ought not to be reduced more than 4 mm. to 5 mm. of mercury. The temperature of the air in the chamber should be from 75° to 80° F.

POSITIVE PRESSURE METHODS.

The arrangements for positive pressure are rather more complicated and require the use of a receptacle into which the patient's head is

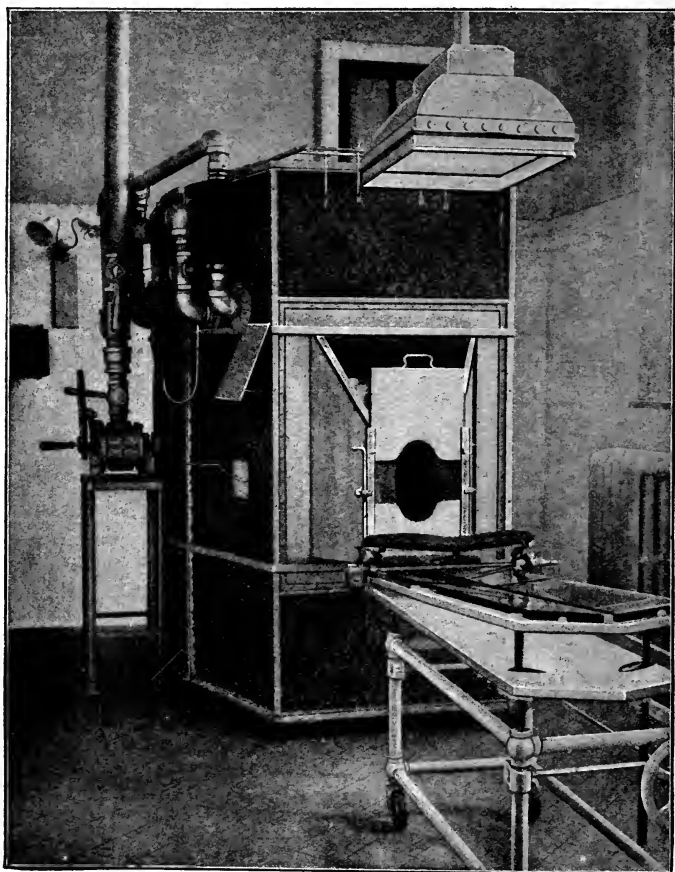


FIG. 58.—WILLY MEYER'S UNIVERSAL DIFFERENTIAL CHAMBER. The cabinet receives the head of the patient, who lies on the operating-table in the larger room. He can thus receive the anæsthetic under increased pressure—positive pressure—or he can receive it under normal atmospheric pressure while the rest of his body in the large chamber can be under decreased pressure—negative pressure. (*Garri and Quincke.*)

inserted (see Fig. 59), except where Willy Meyer's arrangement can be carried out and a small chamber provided in which the pressure can be raised to the necessary degree (about 7 mm. of mercury).

The great advantage of the positive pressure method is that the

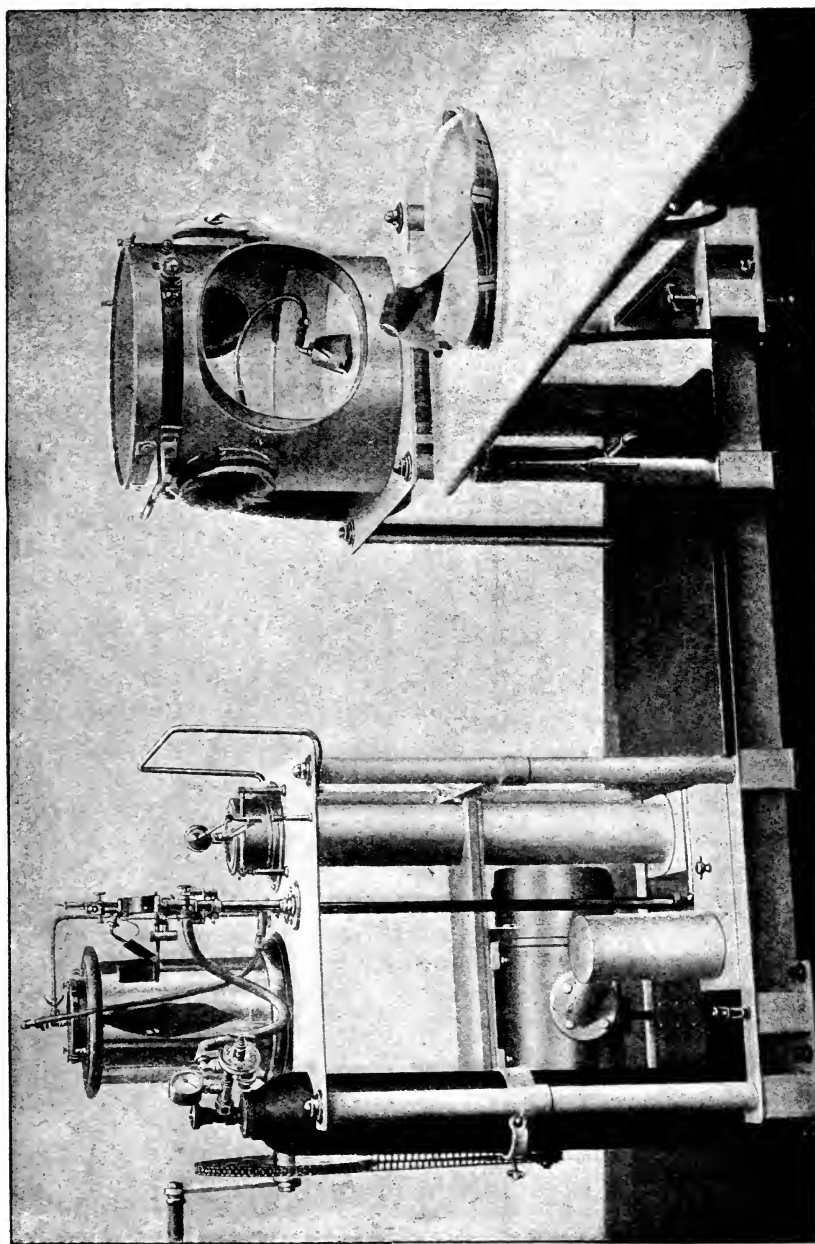


FIG. 50.—BRAUER'S POSITIVE PRESSURE APPARATUS. The patient's head is inserted into the cylindrical receiver standing at the head of the operating-table on the right. On the table is seen the rubber collar which fits over the large aperture through which the head is passed. Inside the cylinder is the anæsthetic face-piece, while in each side are the circular holes fitted with rubber gaundlets for the anæsthetist's hands. The oxygen pressure supply is seen on the left. (*Garre and Quincke*.)

surgeon is left absolutely free and can carry on the operation unhampered by a special chamber or by questions of external pressure.

When a small chamber is used for positive pressure, difficulties arise because the anæsthetist can only handle his apparatus by inserting his arms in rubber gauntlets which are attached to the side of the chamber and which grasp his arm and hands very closely when the pressure is increased. Further, the india-rubber connection around the patient's neck at the lower part of the chamber, which must necessarily be air-tight, tends to bulge downwards when the pressure in the cabinet is increased, and may seriously interfere with the operator

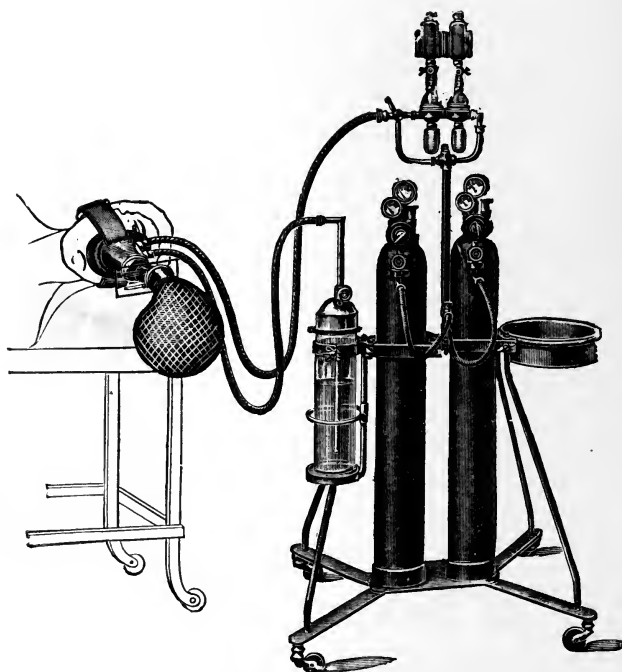


FIG. 60.—TIEGEL'S PORTABLE POSITIVE PRESSURE APPARATUS. The details of the face-piece are seen in the following figure. The water-valve is seen to the left of the two oxygen cylinders. (*Garré and Quinke.*)

or, at any rate, with the asepsis of the wound. The latter difficulty, however, does not seem insuperable. In this method also air is apt to pass down the œsophagus and lead to great dilatation of the stomach which may embarrass the heart, and has in one case at least led to a fatal result.

Attempts have been made to get rid of the chamber and to use a smaller portable arrangement, of which one form (Tiegel's) is shown in Fig. 60. This consists of a face-piece, which is attached to the face by a band round the head, the part next the skin being inflated so as to prevent any escape of air; connected with this mask is a rubber

air-balloon, which makes the respiration more steady, and if the patient vomits the material passes into this balloon. Compressed oxygen is used in this plan, as well as in the chamber, because in these cases the ordinary air is not sufficient to aërate the blood. A water-valve is inserted in connection with the face-piece (see Fig. 61); which regulates the pressure and also allows the escape of the expired air. Arrangements must be made for the introduction of the anæsthetic, the usual apparatus employed being the Roth-Dräger apparatus. Among the disadvantages of this apparatus may be mentioned the difficulty of maintaining a constant pressure and the fact that if vomiting occurs it may be necessary to withdraw the mask, and consequently the pressure suddenly falls and the

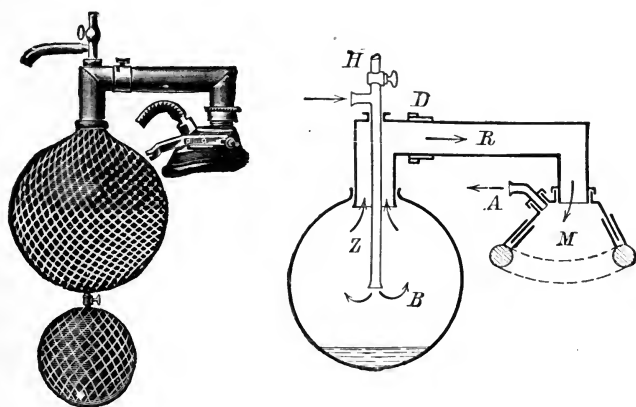


FIG. 61.—TIEGEL'S MASK. *M* is the mouth-piece from which the tube *A* leads to the water-valve. *R* is the respiration-tube through which the mixture of anæsthetic and oxygen under pressure passes to be inhaled. The pressure can be altered by the valve *D*. The oxygen enters the tube, *H*, under pressure, passes over the anæsthetic in the bag, *B*, and thence into the respiratory-tube as an anæsthetic mixture, in the direction of the arrows, *Z*. (*Garré and Quincke.*)

lung collapses. At the conclusion of the operation, cessation of respiration may occur and artificial means to restore it must be employed at once.

Those who have done most work with differential pressure seem to have come to the conclusion that there is not very much to choose between the positive and negative methods, but that on the whole the negative pressure plan is superior to the other.

Another plan has been lately introduced, especially by Meltzer, in which the anæsthetic is administered by intra-tracheal insufflation; this method is referred to in Vol. IV. p. 33. Apart from the administration of the anæsthetic, the aëration of the lungs is kept up by circulating a large quantity of air (or oxygen, if desired) through them, and to a certain extent it may be reckoned as a positive pressure method which may, in some cases, replace the more elaborate plans referred to above.

Meltzer showed that even when both sides of the chest were opened in animals, sufficient aëration of the lungs was obtained if air was blown into the lungs at a pressure of 20 mm. of mercury through a tube passed down through the larynx to the bifurcation of the trachea. This plan has been employed to a considerable extent, and with some surgeons it has taken the place of the other methods to which we have just referred. Meltzer's original apparatus is quite simple, and is practically identical with the apparatus devised by Boyle and Gask and shown in Fig. 62. Elsborg of New York has constructed a more

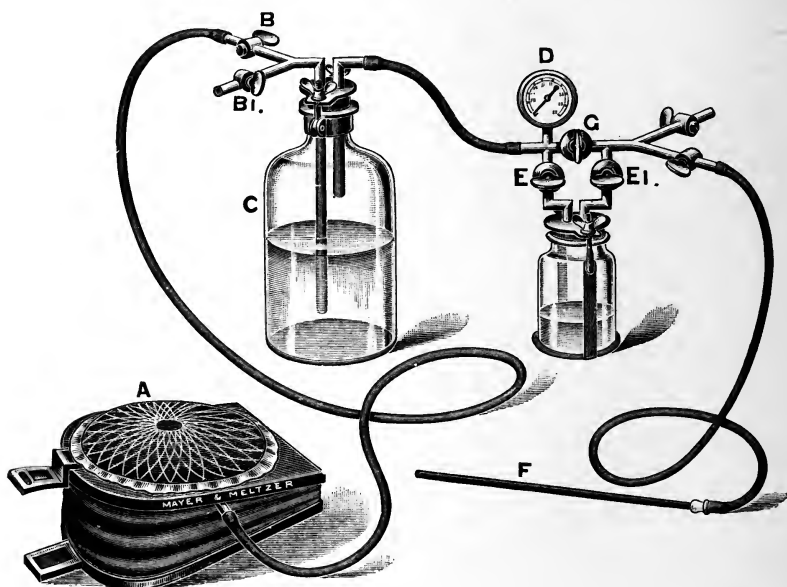


FIG. 62.—BOYLE AND GASK'S INTRA-TRACHEAL ANÆSTHETIC APPARATUS. Air is driven from the bellows, A, through hot water in the bottle, C (the tap, B, is for air, and Bi is a reserve tap for oxygen if necessary). The air then passes through E, over the surface of the ether in the smaller bottle, and so on to the gum-elastic catheter, F. When it is desirable to give air without ether, E, Ei are turned off and G is turned on. By regulating these taps, it is easy to have the whole or part of the air laden with ether vapour. The manometer, D, registers the pressure under which the air is driven into the trachea.

elaborate apparatus on the same principle, which can be moved about, and which is described and figured in Vol. IV. p. 34.

The patient is first anæsthetised, and then a silk catheter about 24 French gauge is passed through the glottis until it is about an inch and a half above the bifurcation of the trachea. The catheter varies in size with the age of the patient, and should only be about half the calibre of the trachea, so that the air can readily escape alongside it. The chief trouble in the method is the introduction of the tube into the glottis; in order to avoid carrying in septic material with the tube its introduction is best effected by the aid of a Killian's or Jackson's direct laryngoscope.

THE TECHNIQUE OF OPERATIONS UNDER DIFFERENTIAL PRESSURE.

Either local or general anæsthesia may be employed during the operation. The latter should be used in exploratory operations, and when the lung has to be extensively handled. Morphine may be given in combination with a general anæsthetic, and is the best way of avoiding the 'pleural reflex,' which results in slowing of the pulse and respiration, and sometimes in sudden death.

The temperature of the operating-room must be maintained at 70° to 75° F. In operations for abscesses or gangrene of the lung, the patient should not be turned over on the sound side, even during the administration of the anæsthetic; he must be placed with the diseased side lowermost, and in many cases it is advantageous during the operation to have the patient lying with the side to be operated on well over the side of the table and to perform the operation from below.

Great care must be taken to prevent the introduction of sepsis into the thoracic cavity. Patients who have been otherwise successfully operated on have died from septic infection of the mediastinum, lungs, and pleura. Drainage of the pleura should be avoided if possible, and if any accumulation occurs or septic infection follows, it may be treated by aspiration or by re-opening the pleural cavity. Drainage is necessary in septic cases or suspected cases of infection.

The operation of Thoracotomy.—The site of the operation is determined by the situation of the lesion or affection to be dealt with. A free incision, either straight, curved, or in the form of a flap, should be made in the skin. The apex of the lung may be reached by removal of the second, or second and third, ribs in front. It is unadvisable and generally unnecessary to attempt the removal of the first rib. If it has to be done, the rib should be removed



FIG. 63.—DE QUÉRVAIN'S RIB-RETRACTORS. Great force can be exerted by slowly screwing the blades apart. (*Garré and Quincke.*)

piecemeal by cutting-forceps. The lower and middle lobes may be reached by removal of the lateral and posterior parts of the sixth, seventh, and eighth ribs. At first, only a sufficient portion of the ribs should be removed to enable the condition of matters to be ascertained; more may be excised if required. The ribs should be removed sub-periosteally. A temporary resection of a portion of the chest wall may also be done. In opening the pleura, only a small incision must be made at first. If the operation is done without differential pressure, the lung must be brought up to the surface and held by stitches or by forceps as the pleura is opened more widely. If differential pressure is used, this is maintained as the pleura is opened, and raised to 7-9 mm. of mercury, which is the most convenient pressure for examinations of the lung. Powerful broad retractors (Fig. 63) are used to pull the ribs as far apart as possible. As the wound in the pleura is closed, the pressure is increased so that pneumo-thorax is diminished as much as possible. If a differential apparatus is not employed the patient should be turned over and the chest compressed. The superficial parts must be carefully sutured.

CHAPTER XX.

THE INFLAMMATORY AFFECTIONS OF THE LUNGS AMENABLE TO SURGICAL TREATMENT.

THE inflammatory affections of the lungs which are amenable to surgical treatment are: acute abscesses and gangrene, more chronic non-tuberculous abscesses, bronchiectasis, and tuberculous vomicae.

ACUTE ABSCESS AND GANGRENE.

These may take the form of simple acute abscesses in the lung substance—generally near the surface of the lower lobe—or of putrid abscesses with gangrene of the lung around.

Simple abscesses are rare, but occasionally occur in cases of croupous pneumonia; not uncommonly localised collections of pus in the pleura—especially between the lobes—are mistaken for abscesses in the lung. These abscesses very soon communicate with the bronchi, and the pus is discharged through the air-passages, and healing may occur in this way. When there is no reason to suspect gangrene (*e.g.* no putrid discharge or expectoration of gangrenous shreds) some time—three to ten weeks—may be allowed to elapse before the question of operation need be urgently considered. If, however, healing does not occur, or if the sputum becomes putrid, surgical intervention becomes necessary, otherwise the patient will go downhill as the result of septic absorption and the insufficient drainage of the abscess and its extension in various directions in the lung. The diagnosis and localisation of these abscesses is very difficult, and on this point medical works must be consulted; the majority are situated low down—especially at the posterior part—and, as a general rule, the exploratory opening of the thorax should be made at the back of the chest below the angle of the scapula. A radiogram may be of value not only in localising the abscess, but also in showing the state of the rest of the lung.

Operation.—All these operations should be performed under differential

pressure or by the intratracheal anæsthetic method, and the patient should lie on his back or slightly turned towards the sound side, with the affected side drawn over the edge of the table, or he may lie on the affected side itself—as for opening an empyema (see p. 220). The skin incision may be made under local anæsthesia, a solution of novocaine (one-half per cent.) being injected into or around the intercostal nerves at various points. The first injection should be made around the nerves at and behind the line of the angle of the scapula where they are single and lie in the middle of the intercostal spaces between the intercostal muscles. Further forwards, they bifurcate—the larger branch lying under cover of the rib above, and here the needle must be directed under each border of the ribs; a wide area of the subcutaneous tissue around the seat of operation must also be infiltrated. Once the pleura is reached local anæsthesia is useless, and a general anæsthetic—preferably, chloroform—must be substituted. As a rule, however, it is more convenient to employ a general anæsthetic from the first, but to suspend its administration after the skin has been divided until the pleura is reached.

An opening should now be made into the thorax, 3 to 4 inches in diameter, portions of at least three ribs being removed in the ordinary manner. It will then become evident whether the pleura is adherent to the lung or not. If it is adherent, the abscess cavity may be sought for over that area by means of an aspirating-needle, and, if found, a free opening may be made into it by a knife, a thermo-cautery, or the diathermic apparatus. The opening is then dilated sufficiently to admit the finger, and the extent and ramifications of the cavity are investigated. Finally, a large drainage tube is inserted, fitting the canal sufficiently tightly to prevent bleeding, the wound is left open, and the ordinary dressings applied.

If there are no adhesions, the pleura is opened under differential pressure, and the condition of the lung is examined. The portion of the lung in which the abscess is suspected is brought up into the wound—if necessary, after further resection of the ribs and division of any pleural adhesions which prevent it coming forward—and the parietal and visceral pleuræ are united by stitches beyond that area. The simplest way of securing an air- and water-tight approximation of the two layers of the pleura is to unite them by a series of locked stitches inserted in the same way as in needlework. The needle is inserted and brought out, and the second insertion is made midway between the points of insertion and emergence of the first. The third insertion is made midway between the points of insertion and emergence of the second stitch—*i.e.* close to the point of emergence of the first, and so on. There is thus practically a double layer of stitches all round the circle. In order to avoid tearing the pleura—especially after the operation, when the patient is removed from the differential chamber—pulmonary tissue on the one hand, and

intercostal muscle on the other, must be included in the stitches. Strips of gauze may now be laid along the line of suture to catch the pus, and the suppurating cavity is explored and opened in the manner just described. If the lung tissue is breaking down, a free opening should be made into the cavity, the contents sponged out, and the cavity thoroughly inspected—if necessary, by artificial illumination. All loose sloughs are removed, any cords crossing the cavity which generally contain blood-vessels are ligatured and divided, and, if oozing is still going on, the cavity is plugged with iodoformed gauze. Sloughs which have not yet separated should be left alone and will come away later.

After-treatment.—The tube is left *in situ* for two or three days until its track is well established, when it may be removed, washed, and replaced; it should be prevented from slipping into the thorax by passing a safety-pin through its outer end. The abscess cavity should never be washed out; the tube should be retained until the discharge is mucoid in character and all expectoration has ceased. If the cavity has been plugged, the gauze should be removed on the second or third day, and if necessary it may be renewed; large drainage tubes should, however, be substituted for the gauze packing as soon as possible. It is suggested that the expansion of the lung tissue should be aided by making the patient breathe air under increased pressure for ten minutes once or twice a day. If the patient is going to recover, the wound generally heals rapidly; but where larger bronchi are involved in the gangrenous process, a bronchial fistula may be left. Among complications which may arise during the after-treatment may be mentioned secondary hæmorrhage, extension of the pneumonic process, pleurisy, and empyema.

CHRONIC NON-TUBERCULOUS CAVITIES.

These are the most suitable cases for surgical interference, but they are only very occasionally met with in practice. When they occur, they are usually due to abscesses that have formed elsewhere and have ruptured into the lung, the typical example being an abscess of the liver. It is obvious that if the abscess can be diagnosed and localised, and the surgeon is able to drain it, the chances of recovery are exceptionally good, as the rest of the lung is healthy, and drainage of the abscess may be carried out at its most dependent part. The principles of treatment and after-treatment are exactly similar to those for pneumonic abscess.

BRONCHIECTATIC CAVITIES.

The great difficulty here is that the condition is generally extensive, and the drainage of one cavity does not necessarily imply the free drainage of others; moreover, the bronchiectasis is not necessarily limited to one

part of the lung or indeed to one lung. Unless, therefore, the symptoms point to the presence of one large cavity, simple drainage is of little value, as it will generally be found that, although the patient improves for a time and the foetid expectoration is much relieved, fresh collections form subsequently and the symptoms recur.

Various other suggestions have been made for dealing with these cases. Extensive costal resection combined with free drainage of such cavities as are accessible, has been tried, but in most cases without success; the part of the lung involved, and even the whole lobe have also been removed, but in the cases in which this has been done the results have not been promising. Sauerbruch has lately suggested ligature of the branches of the pulmonary artery going to the affected lobe so as to lead to collapse of the lung. The successes in these cases have been few, chiefly owing to the fact that the process is often diffused throughout the lung and not infrequently both lungs are affected (see 'The Surgery of the Lung,' by Garré and Quincke).

CAVITIES DUE TO FOREIGN BODIES LODGED IN THE SMALLER BRONCHI.

As a rule, the foreign body becomes impacted near the bifurcation of the trachea, and may be reached by a low tracheotomy wound with or without the aid of Brüning's bronchoscope (see p. 143). A foreign body impacted in the lung may give rise to pneumonia, dilatation of the bronchi behind it, breaking down of the lung, and the formation of an abscess in the lung tissue, or a localised empyema. Hence it is important if possible to remove the foreign body as soon as it is evident that it is going to cause trouble.

When the nature of the foreign body is such that it casts a shadow with the X-rays, a radiogram will greatly facilitate its localisation. Should it turn out that the body is embedded in the lung substance, the surgeon may be called upon to explore that organ, which he will do in the manner already described for an abscess of the lung. Should he have to open an empyema, due to the presence of a foreign body in the lung, he will probably find on introducing the finger that, instead of feeling the smooth external surface of the lung covered by the thickened pleura, his finger passes into a ragged cavity, which is obviously broken-down lung tissue; careful probing may reveal a sinus leading to a bronchus, and may even detect the foreign body. If the latter can be localised, the opening in the chest wall must be enlarged, and the body extracted by suitable forceps. If it is not detected and extracted in this way, it may possibly escape along the track left for drainage subsequently; and this should therefore always be of the largest possible dimensions.

The *after-treatment* is similar to that for the other forms of abscess of the lung (see p. 243), but, although the immediate results may be satisfactory; the constitutional symptoms may rapidly disappear, and the discharge lose its purulent character, the final results are by no means always good, as a sinus discharging thin muco-pus may remain practically indefinitely. We have had one very interesting case in which a boot-button was extracted through the chest-wall after incision of an empyema which communicated directly with an abscess of the lung; through this track the foreign body was felt with a probe and withdrawn. The abscess cavity rapidly contracted, but a bronchial sinus has persisted up to the present time, and has now existed for over twelve years in spite of plastic operations and various other measures designed to obtain closure. The patient has, however, not suffered in any way from the persistence of the sinus, beyond the inconvenience of having to have it dressed repeatedly. He has no signs of lardaceous disease, and the only trouble is a small sinus which communicates directly with the left bronchus, and discharges a thin mucoid fluid, but practically no pus (see *King's College Hospital Reports*, vol. ii. p. 97). Mr. Rutherford Morison, in the *Med. Soc. Trans.* vol. xxxii. 1909, pp. 6-10, publishes a case of pulmonectomy for a foreign body which had been in the lung for two years; the patient died twenty-six days after the operation. Mr. Kellock, in the *Lancet* of January 11, 1913, publishes a case of removal of a foreign body from the lung by direct incision.

PULMONARY FISTULÆ.

These may occur after various operations on the lungs and after the opening of pulmonary abscesses, bronchiectases, or the removal of foreign bodies (*vide supra*). Two conditions may be met with: in the one the fistula is narrow, lined throughout with epithelium, causes little or no inconvenience to the patient, and may be left alone. In other cases the fistulæ are large, and so much air may pass out as seriously to interfere with the aëration of the rest of the lung, or a suppurating cavity may intervene between the bronchus and the external opening. In such cases it may be necessary to make an attempt to close the fistula. This may be done by destroying the epithelial lining—if such exists—closing the opening in the lung, and resecting small portions of the ribs around, so as to let the soft parts fall in. The closure of the opening may be done by stitches inserted deeply in the thickened tissues around, the external parts also being brought closely together over it. When one of the larger bronchi is involved, it may be isolated, the wall crushed and ligatured, the end inverted into the bronchus, and closed in by stitches in the healthy tissues over it, as in invagination of a divided portion of intestine.

PULMONARY TUBERCULOSIS.

Of late years—and especially since the introduction of differential pressure—various operative procedures have been suggested, and some have been carried out, with the view of improving or curing tuberculous disease of the lungs. Unfortunately, from the nature of the case, the success which has followed these attempts has been slight. Among the conditions which render these cases unfavourable for surgical interference may be mentioned the diffuseness of the lesions—not only in that they commonly affect both lungs, but that they are seldom limited to a small area in one lung—the constant movement of the lung, the frequent association of the tuberculous lesion with sepsis owing to its free communication with the bronchi, the low vitality of the patient, and the vital importance of the organ affected.

The following are the chief suggestions which have been made and carried out; the production of artificial pneumo-thorax with the view of producing collapse of the lung, thereby placing the diseased organ at rest and favouring the encapsulation or destruction of the tuberculous foci by the growth of fibrous tissue around them; resection of ribs with the view of permitting partial retraction of the lung and so favouring healing without throwing the lung completely out of action; thoracotomy, combined with ligature of the pulmonary arteries; extirpation of the diseased lobe; opening and draining cavities in the lung; and division of the costal cartilages. Of these the only procedures which seem to promise benefit are resection of the ribs and the production of artificial pneumo-thorax.

Resection of the ribs has been carried out in various ways in these cases; sometimes considerable portions of a number of ribs have been removed; sometimes only an amount sufficient to mobilise the chest wall; sometimes the lower ribs are first dealt with and the upper at a later period; sometimes only the second and third ribs are removed almost entire. This procedure is a much more serious one than the production of pneumo-thorax, and it is only warranted in patients whose condition is good. When the ribs are extensively mobilised, the respiration and the heart's action may be seriously embarrassed; the movements of the lung may be much increased, coughing becomes more difficult, and it is necessary to support the parts by a firm bandage. It is doubtful whether this method constitutes any real advance in the treatment of these cases.

The production of artificial pneumo-thorax, on the other hand, when employed in suitable cases, is apparently of great value, and is to a great extent free from the risks of the other operations. It consists in the introduction into the pleural cavity, on the affected side, of sufficient air—or, preferably, nitrogen gas—to lead to collapse of the lung. The gas is

introduced under a pressure of 4 mm. to 6 mm. of mercury, and on the first occasion from $\frac{1}{2}$ litre to 1 litre is sufficient. The dyspnoea, which at first arises, quickly passes away as the result of increase in the respiratory movements on the other side. Nitrogen is preferred to air or oxygen because it is not so quickly absorbed. After an interval of two days, a second injection of 300 c.cm. to 1000 c.cm. of nitrogen should be made, the interval varying with the rapidity of absorption and the capacity of the chest. Subsequent injections should be made at intervals, which can be gradually lengthened, and the treatment must be kept up for one to two years. The result, in suitable cases, is that the amount of sputum diminishes, the condition of the patient improves, and the tuberculous foci become encapsuled or destroyed; when the injections are discontinued, the healthy parts of the lung again expand, and respiration is restored. The method is only applicable when the other lung is healthy or only slightly affected, and is contra-indicated when both sides are extensively diseased, when there are extensive pleural adhesions, or when there is serious tuberculous disease elsewhere. For the details of this method and of the apparatus employed, we must refer our readers to special works—such as the 'Surgery of the Lung,' by Garré and Quincke (Bale, Sons, & Danielsson, London, 1912).

PULMONARY EMPHYSEMA.

Freund has pointed out that, apart from the alterations in the lung tissue which occur in pulmonary emphysema, a not very uncommon cause of the enlargement and barrel shape of the chest and the consequent impediment to respiration, is calcification and elongation of the costal cartilages—especially the first and second. He has therefore suggested that in cases in which the rigidity of the thorax is due to this condition, portions of several costal cartilages should be removed. The existence of these changes may be ascertained by radiograms or by thrusting a needle into the cartilage. Normal cartilage offers an elastic resistance to the needle, but when degenerative changes have occurred, it either becomes arrested by the calcareous material or slips readily in cavities in the cartilage due to the degenerative changes. The chest is no longer elastic on compression, and it is barrel-shaped. The improvement in the condition of a considerable number of the patients operated on has been remarkable.

The operation is simple, and consists in taking out wedge-shaped pieces, about one inch in length, of the second, third, fourth, and fifth costal cartilages, in practically the same manner as in resection of the ribs. The pleura is detached, but the whole of the perichondrium must be taken away, otherwise fresh bars of cartilage may form. By interposing a piece of muscle or fascia between the divided ends, the formation of a

false joint is ensured. A vertical incision over the middle of the cartilages to be removed will give easy access. The chief contra-indications are the presence of acute bronchitis or broncho-pneumonia, and cardiac insufficiency. Usually, it suffices to perform the operation on one side—preferably, the right.

CHAPTER XXI.

PULMONARY ACTINOMYCOSIS: HYDATIDS OF THE LUNG AND PLEURA: NEW GROWTHS OF THE THORAX.

PULMONARY ACTINOMYCOSIS.

THIS is a rare affection, and may result from inhalation of the fungus, by extension of the disease from the œsophagus or other adjacent organs—such as the liver—or as a result of embolism. In the early stages, the symptoms are obscure, but as the disease spreads from the lung to the pleura and thence to the chest wall, the probability of accurately diagnosing the condition increases. It may be recognised comparatively early by the expectoration of the characteristic fungus; in other cases it may not be diagnosed until the chest wall has become involved and sinuses have formed, giving the characteristic discharge.

TREATMENT.—These cases have been treated with more or less success partly by the administration of large doses of iodide of potassium, and partly by opening up the mass and scraping it away as completely as possible with a blunt spoon or with the aid of the diathermic cautery. These masses are often extremely vascular, and there may be much difficulty with hæmorrhage so that the surgeon may have to plug the cavity firmly in order to arrest the bleeding, unless the diathermic cautery is employed. Repeated scrapings will probably be necessary. By resection of the chest wall, indurated masses in the lung may be excised when the disease is localised.

HYDATIDS OF THE LUNG AND PLEURA.

Hydatid disease is not very uncommon in the lung; from 7 to 12 per cent. of all cases of hydatid cysts occur in that organ, and the cysts are met with especially in the lower lobe of the right lung. The disease may commence primarily in the lung, or may be secondary to the bursting of a hydatid of the liver through the diaphragm into the pleural cavity,

and the patient may present himself not only with a hydatid of the pleura, but also with one of the liver. The cyst may rupture into a bronchus and lead to suffocation; usually, however, the discharge of fluid takes place more slowly, and hooklets or portions of the cyst wall may be found in the expectoration. If this has not yet occurred, the diagnosis of the condition is difficult in the early stages, but much assistance as to the position of the cyst may be obtained by a stereoscopic radiogram—a dark shadow or ring being seen. The blood should be examined for eosinophilia and for fixation of complement. The latter test is made in a similar manner to the Wassermann reaction for syphilis (see Vol. I. p. 508).

TREATMENT.—When the presence and situation of the hydatid have been made out, portions of two or three ribs should be removed and the lung explored; the further procedure will depend upon whether the hydatid cyst is adherent to the parietal pleura or not. If it is adherent, it is only necessary to incise the cyst and allow its contents to escape, after which efficient drainage is provided. If, however, there are no adhesions to the parietal pleura, the two layers of the pleura must be carefully stitched together before the cyst is opened. No attempt should be made to wash out the cyst. In some cases the cyst has been punctured, and a small quantity of a 1 per cent. solution of formol has been injected so as to kill the parasites; five minutes later, the cyst may be opened and the endocyst detached. This usually comes away quite easily, but no attempt should be made to remove the ectocyst. When possible, differential pressure should be employed during the operation. If it is not possible to use this method, the occurrence of a pneumo-thorax is almost unavoidable, but little danger will arise if it is allowed to form slowly. When the cyst is small, the wall may be closed with stitches after the endocyst has been removed, and the opening in the chest is then closed, but in most cases it is advisable to introduce a drainage tube for a few days.

NEW GROWTHS OF THE THORAX.

Tumours outside the thorax are treated on lines similar to those for tumours of soft parts elsewhere. Tumours of the lung are practically not amenable to surgical treatment, and the only cases which we need consider here are those in which growths arise in connection with the thoracic wall—particularly the ribs—and dermoid cysts growing in the mediastinum.

TUMOURS OF THE RIBS.

These may be simple—such as exostoses or enchondromata—or malignant, the latter being either sarcomata or carcinomata. Extensive

enchondromatous and sarcomatous tumours of the chest wall have been successfully removed, but it is a question whether it is ever worth while to attempt the removal of carcinomatous masses from this situation, as they are generally secondary to scirrhus of the breast, and the condition is most unfavourable. In some cases of small cancerous nodules in a rib, a portion of the bone may be removed, but when the disease has spread to this extent, the chances of eradicating it are very slight. Sarcomata are somewhat more favourable, and, when the growth is limited, a good result may follow a free operation, in which the pleura beneath the tumour must also be removed. When, however, the sarcoma involves the skin to such an extent that the opening cannot be satisfactorily closed, operation is contra-indicated. These operations must be done under differential pressure ; if that is not available, only small tumours, in which the opening in the thorax can be satisfactorily closed, should be operated upon.

The operation consists in turning aside a suitable flap so as to expose the whole of the tumour, and denuding the ribs at the point where they are to be divided. The periosteum is peeled off at that part, the ribs are resected, and for convenience in working, it is well to take out about half an inch of the ribs all round the tumour, so that, before there is any risk of opening the pleura, the tumour is isolated from the chest wall and is merely attached by the pleura and intercostal muscles ; it now only remains to divide these structures. When differential pressure is not available, the pleura should be first opened by a small puncture, and a sponge wrung out of salt solution placed over the opening, and air gradually allowed to enter the thorax. The chief risk in inducing a pneumo-thorax is the sudden entry of air. If, however, this occurs very gradually and the operation is suspended until a condition of equilibrium has been restored, the risks are slight. When the air has filled up the thoracic cavity, the surgeon can safely proceed to clip away the tumour with its attached portion of thoracic wall and pleura, the assistant meanwhile clamping each intercostal vessel as it is divided. Cloths wrung out of hot salt solution are thrown over the opening should it be found that the operation will have to be prolonged owing to adhesion of the tumour to the diaphragm or to any other structure ; of course, should the surgeon have reason to believe before operation that such adhesions exist, he would not attempt the operation.

When the tumour has been removed and the bleeding arrested, the skin-flaps are closely sutured, the air in the pleura soon becomes absorbed, and the lung resumes its functions. When possible, drainage of the pleura should be avoided. If any fluid should collect in the cavity, it may be evacuated by an aspirating-needle. Appropriate remedies may be needed to meet the severe shock that such an extensive operation entails.

Nothing need be said concerning tumours of the lung itself. Portions

of the organ have been excised for tumour, but the results are not encouraging. Those interested in the subject should consult the special monographs dealing with the surgery of the lungs.

DERMOID CYSTS OF THE MEDIASTINUM.

These tumours, of which there are several cases on record, originate in the mediastinum—usually in front of the great vessels. They are generally unilocular cysts, and may be noticed in youth or early adult life. As they increase in size, they exercise pressure on and cause displacement of the adjacent structures. On X-ray examination, a dark shadow is seen. They may extend up into the neck, and not uncommonly suppurate. Spontaneous rupture may occur into the bronchi or trachea; or through the skin, leading to a permanent fistulous opening. The treatment is difficult, and consists in excision, which may, however, be incomplete, and, if so, the result is not satisfactory, as a fistula, from which the contents of the cyst and pus escape, is usually left after operative treatment. In a few cases the cyst has been completely extirpated.

CHAPTER XXII.

OPERATIONS FOR PERICARDITIS: CARDIOLYSIS: OPERATION FOR PULMONARY EMBOLISM: REMOVAL OF THE THYMUS GLAND.

OPERATIONS FOR PERICARDITIS.

PERICARDITIS may be simple or suppurative, acute or chronic; the acute cases belong to the department of the physician, except in so far as the removal of fluid is concerned. In simple serous pericarditis, the embarrassment of the heart's action from the pressure of the effusion may be so great that paracentesis pericardii may be required, but the surgeon is most often called in for cases of purulent pericarditis, for which incision and drainage are necessary.

Paracentesis of the pericardium.—This is performed by inserting an aspirating- or large exploring-needle through the fifth intercostal space, an inch to the left of the margin of the sternum. This point is chosen so as to avoid the internal mammary artery, and it will also avoid the pleura if the pericardium is distended. The greatest care must be taken with the aseptic precautions, and it is well to divide the skin with a tenotomy knife as a preliminary measure, so that the needle may be inserted without using any force; the needle should be passed in slowly and steadily, because a sudden thrust might injure the heart. If the aspirating-bottle is used to withdraw the fluid, it should be attached to the needle during its progress through the tissues, so as to show at once when the fluid begins to escape. The small puncture is closed by a collodion dressing.

Drainage of the pericardium.—This is usually effected through an incision in the fourth or fifth intercostal space, but better room is obtained if a portion of the fifth costal cartilage is excised. An incision should be made over the whole length of the fifth costal cartilage, and special care must be taken not to wound the internal mammary artery in separating the cartilage from the surrounding structures.

After the cartilage has been removed, the pleura, which overlaps the pericardium externally, should be looked for and pushed aside. The pericardium is identified and seized close to the left border of the sternum, and an incision is made through it obliquely downwards and outwards from the edge of that bone. After the pus has escaped, a drainage tube is inserted, care being taken that it does not project into the pericardium further than is necessary to secure drainage, lest injurious pressure be exerted upon the heart.

Another method, first suggested by the late Herbert Allingham, is to approach the pericardium from the lowest point between the xiphoid cartilage and the costal cartilages. A vertical incision, some four and a half inches long, is made parallel to, and one inch to the left of, the border of the sternum with its centre at the lower border of the seventh costal cartilage. The skin and fascia are reflected inwards and outwards, and the abdominal muscles detached from the seventh costal cartilage. The 'costo-xiphoid space,' containing the superior epigastric artery, is then opened up, some of the muscular fibres of the diaphragm being torn through; as the pericardium is distended, it is brought into view quite easily. In order to obtain sufficient room to insert the fingers, two inches of the seventh costal cartilage may be removed. The superior epigastric artery is exposed and held aside; or divided and ligatured, and a portion of the sixth costal cartilage may be taken away so as to give the surgeon room to introduce his finger into the cavity. A large drainage tube is then inserted so that its end lies just in the pericardial sac. By operating by this method, the pericardium is drained at its lowest point and a complete exploration of the cavity can be made. The after-treatment is conducted on general medical and surgical lines, the patient being placed in a sitting posture.

CARDIOLYSIS.

In cases of aortic disease accompanied by enormous enlargement of the heart (*cor bovinum*), and when the parietal and visceral layers of the pericardium are adherent with adhesions between the outer surface of the parietal layer and the adjacent structures, the heart's action may be much interfered with. To relieve the strain on the heart, the operation of cardiolysis has been suggested, and is performed in the following manner: A large flap is raised, including all the tissues down to the ribs and sternum, the base of the flap being at the right border of the sternum, the upper margin being at the lower border of the third left costal cartilage, and the lower margin along the sixth costal cartilage. The outer extremity of the flap should be over the junction of the fourth and fifth left costal cartilages with their corresponding ribs. The portion of the sternum between the lower border

of the third and the upper border of the sixth rib, together with the fourth and fifth costal cartilages on the left side, are carefully removed and the pericardium exposed. The flap is then replaced and sutured in position.

TRENDELENBURG'S OPERATION FOR EMBOLISM OF THE PULMONARY ARTERIES.

Embolism of the pulmonary arteries may arise from various causes, but, from the nature and suddenness of the affection, operation for the removal of the embolus will only be possible in very few cases. When, however, the signs and symptoms last for a short time—say, half an hour—and the patient is under conditions suitable for an operation, an attempt may be made to remove the embolus from the pulmonary artery. Up to the present time, the operation has been done only a few times, and in no case has a permanently successful result been obtained. One patient, however, lived five and a quarter days, but succumbed to purulent pleurisy.

The orifice of the pulmonary artery is situated behind the sternal end of the left third costal cartilage, and the artery bifurcates at the upper margin of the second left costal cartilage. The artery and the aorta are enclosed by the pericardium, and the visceral layer of that sac envelops the two vessels. Behind them is a space, the sinus pericardii, formed by the pericardium passing from the vessels to the auricles. The anterior margins of the left lung and the pleura overlap the artery, and the left phrenic nerve passes in front of the pericardium as it surrounds the vessel. Behind it is the origin of the aorta, and the left auricle; to its right is the ascending aorta. The sinus pericardii in an adult will admit the finger, and this space makes it possible to penetrate on the left side close to the pulmonary artery and to come out on the right side again near the aorta (Garré and Quincke)

Trendelenburg's operation is performed under differential pressure in the following manner: A transverse incision on the left side, four and a half to five inches long, is carried outwards from the sternum along the second rib, and a vertical one along the inner ends of the costal cartilages of the first, second, and third ribs. The flaps, containing all the tissues down to the second rib, are dissected up, and that cartilage and rib are resected for the full length of the transverse incision. If necessary, a shorter piece of the third rib may also be removed. The pleura is now opened for the whole length of the incision and kept widely open by retractors. The lung is allowed to collapse to a certain extent, and the pericardium, which now becomes visible, is lifted up by two pairs of forceps and incised vertically, care being taken not to damage the phrenic nerve. The incision in the pericardium is held open with forceps, and a special hook-shaped probe can be introduced and passed

round the left side of the pulmonary artery, keeping as close to the heart as possible, and made to appear on the right near the aorta. A rubber tube is fixed to the head of this probe, which is withdrawn, leaving the tube in its path. The tube is used to compress the vessel, and the amount of compression can be varied from time to time, so as to allow the blood to pass when desired. The visceral layer of the pericardium should be freed from the artery, so that the final suture may be more readily performed. A longitudinal incision is now made through the coats of the artery, whilst the elastic compression is maintained, and a curved polypus-forceps is then introduced into the lumen of the vessel, and the embolus searched for in the main trunk and branches, seized with the forceps and withdrawn. By a special pair of forceps, applied to the walls of the artery outside of and parallel to the incision in it, the incision is temporarily closed and the compression tube removed. The margins of the incision in the vessel project beyond the blades of the forceps and are now sutured with fine silk in a round needle. The clamp is removed and extra sutures are inserted where necessary. The incision in the pericardium is closed and also that in the pleura, and the flaps of the chest wall are replaced and sutured. It will be necessary to perform artificial respiration after the operation, and this should be continued for some time after the patient has commenced to breathe spontaneously, and oxygen should be given—if possible by intratracheal insufflation.

There are two special points to be attended to in the operation : (1) not to maintain the interruption to the circulation too long ; (2) to avoid sepsis.

In the cases operated on up to the present, the removal of the thrombus has always been incomplete.

REMOVAL OF THE THYMUS GLAND.

Removal of the thymus gland has been carried out when it is enlarged, and causes by its pressure—especially in congestive attacks—dyspnœa and venous engorgement of the vessels in the neck. There is much diversity of opinion as to the normal size and weight of the thymus, and its exact functions are unknown ; it does not appear to be essential for the well-being of the body. It is known to be frequently enlarged in Graves's disease, but the relationship of the enlargement to the symptoms of that disease are obscure. It is also known that the thymus is enlarged in many of the cases spoken of as 'status lymphaticus.'

The operation has most frequently been performed on young infants or children—most of the patients have been between one and two years of age. The whole of the gland, or one lobe only, may be taken away

according as may seem to be necessary ; it is generally easier to remove the left lobe first, as it lies at a higher level than the right.

A curved transverse incision is made low down in the neck. After division of the platysma and deep fascia, the inner edges of the sterno-mastoid muscles are detached and the infra-hyoid muscles divided. During respiration, the enlarged thymus will be extruded ; it is recognised by its pinkish or grey colour. The gland is seized with forceps and held gently forward, whilst the finger enucleates it from the loose fascia surrounding it. The vessels are secured by forceps and tied with catgut. The cavity left is not drained, the muscles are sutured, and the skin incision closed.

Both the immediate and remote results would appear to be excellent. There is very little shock after the operation. The children, who are generally poorly nourished prior to the operation, begin to improve in health, and the dyspnœa and suffocative attacks disappear (see Mayo, *Annals of Surgery*, July 1912, and Olivier, *Arch. gen. de chirurgie*, February 25, 1912, and *Journal de Chirurgie*, March 1912).



DIVISION IV.

THE SURGICAL AFFECTIONS OF THE GENITO-URINARY ORGANS.

SECTION I.—AFFECTIONS OF THE PENIS, SCROTUM, AND TESTIS.

CHAPTER XXIII.

PHIMOSIS AND PARAPHIMOSIS : CHANCROID OR SOFT SORE.

PHIMOSIS.

THIS is a condition in which the prepuce cannot be drawn back over the corona glandis ; it may be congenital or acquired, and varies in degree from cases in which the orifice of the prepuce is so tight that the meatus urinarius cannot be exposed at all to those in which it is only the base of the glans that cannot be uncovered.

Congenital phimosis.—In the congenital form the chief trouble is at the preputial orifice—*i.e.* the junction of the mucous and cutaneous surfaces. Adhesions are nearly always present between the prepuce and the glans and may be firm and dense—so that when they are separated a raw surface is left—or so slight that the two structures may be separated without causing any bleeding. In some cases the difficulty in retracting the prepuce may be entirely due to these adhesions, and not to the narrowness of the preputial orifice. The prepuce is generally unduly long, and in some cases the orifice of the urethra is also contracted.

The condition is accompanied by an accumulation of smegma beneath the prepuce, which may give rise to some irritation from its mere presence, but does not necessarily cause balanitis unless pyogenic organisms find entrance. Infection is, however, almost certain to occur as the child grows older, and then severe balanitis may occur. Difficulty

in micturition may also be present when the preputial orifice is very narrow or the urethral orifice too small, and this may lead to undue frequency which in bad cases may amount almost to incontinence. There may also be straining on micturition, which predisposes to hernia and may produce prolapse of the rectum. The reflex irritation due to the adhesions may be very marked and is a frequent cause of masturbation as the child gets older, whilst in adult life very serious results may follow the occurrence of venereal disease. When the preputial orifice is very narrow there may be severe backward pressure in the urinary passages from obstruction to micturition. Finally, the constant irritation from the retained secretion may be a predisposing cause of epithelioma.

The amount of contraction may diminish in time. Hence, although circumcision is a valuable method of treatment, it is not essential in all cases, and, when the preputial orifice is not so tight as to interfere with micturition, and when there are no other symptoms present and the parents object to circumcision, the condition may be left, in the hope that it may improve as the child grows up.

Acquired phimosis.—The most common cause of acquired phimosis is inflammation, such as frequently recurring balanitis beneath an unduly long prepuce; this causes thickening of the prepuce and narrowing of its orifice. A similar condition may follow cicatrisation of multiple soft chancres about the preputial opening. Phimosis may also result from a faulty circumcision in which too small a portion of the prepuce has been taken away and the mucous membrane has not been slit up sufficiently.

TREATMENT.—(a) *Of congenital phimosis.*—When the trouble is due to adhesion of the prepuce to the glans without excessive elongation of the former or narrowing of its orifice, it may suffice to separate the adhesions so as to allow the prepuce to be retracted. The best plan is to insinuate the flattened end of a probe between the prepuce and the glans, pass it as far back as possible, and then sweep it around the glans, so as to commence the separation of the adhesions. The prepuce is then retracted and, as the glans appears, it is steadied with one hand whilst the prepuce is peeled back with the thumb of the other. As the prepuce is fully withdrawn small masses of smegma are exposed, and should be removed. The glans must be completely exposed, and particular care taken to remove all the smegma in the neighbourhood of the frenum. There is no need for an æsthetic, and there is no bleeding unless the adhesions are firm. The manipulations are a little painful while they last, but the pain ceases immediately the prepuce is drawn forward again. If the retraction of the prepuce has been effected without the occurrence of any bleeding, all that is necessary is to smear the glans over with vaseline and then to draw the prepuce forward. The nurse should be instructed to draw it back every morning and evening when the child is washed, and to see that the glans is kept

clean and free from adhesion. It is important to caution her not to keep the prepuce back for any length of time, otherwise it may become swollen and there may be difficulty in pulling it forward again; in other words, paraphimosis may occur. In the course of a week or two the cure is complete and there is no likelihood of the adhesions recurring.

If, however, a considerable raw surface is left when the prepuce is retracted, it is best to proceed to circumcision, because balanitis must otherwise result and the treatment will be painful and probably imperfect. Some surgeons object to circumcision and prefer to dilate the narrowed preputial orifice repeatedly with a special instrument like a glove-stretcher until the tendency to contraction has been completely overcome. This method, however, is unsatisfactory and if employed, must be done gently, so as to avoid any cracking of the mucous membrane, which would give rise to inflammation and cicatricial contraction. There is no valid objection to circumcision, and indeed it possesses great advantages, especially as a precautionary measure against masturbation.

Circumcision.—This operation may be performed in various ways; the method that we prefer is as follows. The preputial orifice is seized on each side of the middle line with catch-forceps, pulled well forward, and put upon the stretch. One blade of a pair of blunt-pointed scissors is insinuated between the prepuce and the glans and the whole thickness of the prepuce is slit up in the middle line of the dorsum as far as the corona glandis (see Fig. 64, *A*). Care must be taken that the blade of the scissors does not injure the glans or pass into the meatus; it is sufficient to mention the risk of such an occurrence, which should not happen with the exercise of ordinary care. As soon as the first incision has been made, the glans is seen, and can be freed from the adherent prepuce right back beyond the corona. A third pair of forceps is placed upon the frenum and the redundant prepuce is cut away on each side (see Fig. 64, *B*) with scissors. Enough mucous membrane must be left to overlap the corona comfortably and, if the parts are divided as shown in the figure, the frenum will not be touched, and therefore the unsightly cedematous swelling, which takes a long time to disappear and which is so often seen after this operation, will be avoided. The incision usually runs about a quarter of an inch from the corona, and this leaves sufficient prepuce to cover the latter easily. Any bleeding points are twisted; it is very important to stop all hæmorrhage before proceeding to suture the cutaneous to the mucous surface, otherwise bleeding may occur into the substance of the prepuce and lead to an unsightly and troublesome hæmatoma. Fine catgut sutures are now made to approximate the cutaneous and mucous surfaces, so as to secure primary union everywhere. It is usually sufficient in the case of young children to place one suture on the dorsum, one at the frenum, and one about half an inch to each side of the frenum, but in adults more sutures

may be required. In very young children the penis is often very small and retracts into the scrotal tissues : when this is the case, the organ can be rendered more apparent by pressing the tissue back around its root by means of the ring of a pair of Spencer Wells's forceps.

Another method of performing circumcision which is very commonly employed is to take a pair of dressing-forceps and place them upon the organ just in front of and parallel to the corona glandis when the penis is lying in its normal condition. The blades of the forceps are then very

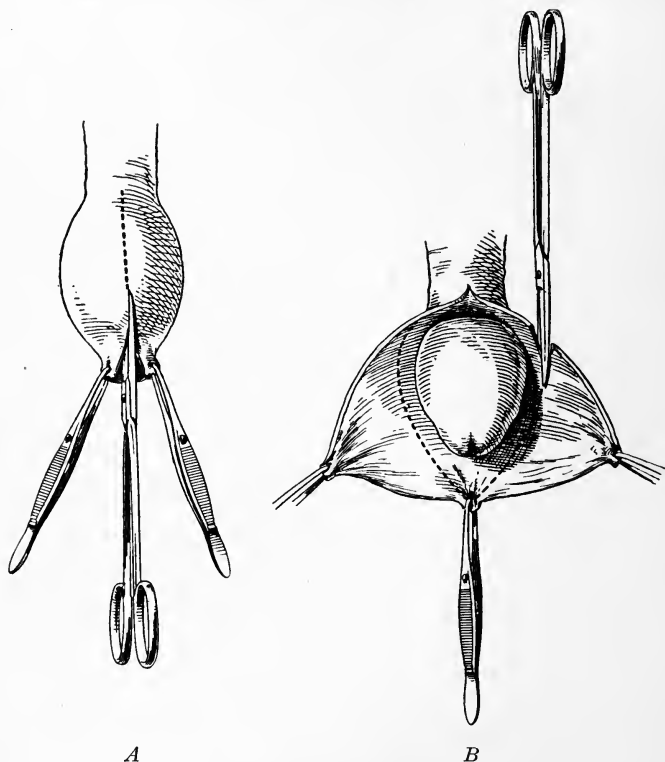


FIG. 64.—CIRCUMCISION. This is the method recommended in the text. *A* shows how the preputial orifice is put on the stretch as the prepuce is slit up; *B* shows how both layers of the prepuce are pared away together along the dotted lines.

gently closed (see Fig. 65, *I*), the glans being allowed to slip backwards as this is done, so that finally the forceps are closed upon the redundant prepuce which lies in front of the glans and is pulled somewhat forwards. The portion projecting beyond the forceps is clipped off with a pair of scissors and the forceps are removed. The latter must not grip the prepuce too tightly otherwise bruising may occur, which will interfere with healing. This incision removes the cutaneous portion of the prepuce, but does not cut away enough of the mucous membrane, which must therefore be slit up in the middle line of the dorsum right back to the

corona, as in the previous operation (see Fig. 65, *II*). Before doing this it is often possible to secure the two small arteries which enter the prepuce on the dorsum, and if this can be done before they have retracted into the loose tissue of the penis a good deal of trouble is often obviated. The adhesions are then separated as before, and the redundant mucous membrane of the prepuce is clipped away along the same lines as in the previous operation, after which the bleeding is stopped and the wound sutured. The after-treatment is similar to that of the first method. In all cases the greatest care should be taken to obtain complete hæmostasis.

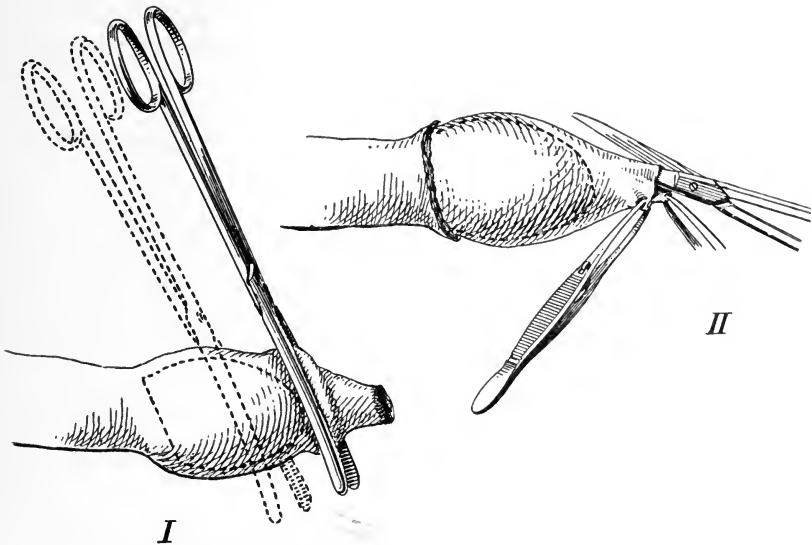


FIG. 65.—ANOTHER METHOD OF PERFORMING CIRCUMCISION. *I* illustrates the method of estimating the amount of prepuce to be removed. The forceps are applied to the flaccid organ in the position of the dotted outline, *i.e.* just in front of the greatest transverse diameter of the glans. On gently closing their blades the glans slips back and the portion of the prepuce to be removed remains in front. *II* shows how the divided margin of the skin has retracted behind the corona glandis.

If this is not done, the penis may be much distended with blood a few hours after the operation, the unsecured vessels having retracted under the skin where they have gone on bleeding. If this happens, the child should be anæsthetised, the clots squeezed out, and the bleeding points secured.

In performing this operation it is important to cut the mucous membrane of the prepuce obliquely, as shown in Fig. 64. If too much is removed, a very troublesome triangular surface will be left below the frenum, which takes a considerable time to heal and leaves a sensitive, ugly swelling for a long time.

After-treatment.—These wounds will heal well without any dressing at all, but a common plan is to wind a strip of wet boric lint or ribbon

gauze around the line of union and lay a large layer of wet boric lint over this, so as to cover the whole penis and scrotum; this is covered with oiled silk or jaconet, and kept in position by the child's napkin. The mackintosh and the larger piece of lint are removed when the napkin is changed, and the glans is douched afterwards with warm boric lotion. Fresh outer dressings are then applied, and this is repeated for a few days until the parts have healed. If ribbon gauze has been employed it can be soaked off after two or three days; boric lint will usually have fallen off after about twenty-four hours, and it will then suffice to lay a piece of wet boric lint over the part. The stitches may be removed on the fourth or fifth day if they have not become absorbed. The child should be kept in bed for the first three or four days, otherwise the friction of the clothes against the wound may cause pain.

(b) **Of acquired phimosis.** — When operation is required for contraction after healing of a venereal sore or after balanitis, it may, if desired, be performed as above described; in these cases comparatively little of the prepuce need be removed. When, however, the patient does not desire complete circumcision, a very useful method is to slit up the prepuce in the middle line of the dorsum to a sufficient extent to allow the glans to be thoroughly uncovered and then to unite the mucous to the cutaneous surfaces along the line of incision so as to convert it into a V-shaped opening which enlarges the preputial ring. As healing progresses, this V-shaped notch gradually becomes opened out, until finally it disappears entirely, and in place of it there is a preputial orifice of sufficient size. Ordinary circumcision, however, is preferable to this operation, especially if there are extensive adhesions between the glans and the prepuce.

PARAPHIMOSIS.

This term implies inability to draw the prepuce forward again after it has been retracted over the glans. It generally occurs when the preputial orifice is somewhat narrow, either congenitally or for some other reason. If a tight prepuce has been retracted and kept back for some time the constriction exerted by the preputial ring leads to œdema of the prepuce, and it is then difficult to pull the prepuce forward again. If this condition of affairs lasts for some time, the swelling increases and ulceration of the mucous membrane takes place at the point of constriction.

The appearance of a typical case of paraphimosis is quite characteristic. Immediately behind the corona glandis there is a fold of œdematous mucous membrane, which is often so distended with fluid as to be quite translucent. Behind this is a deep groove, at the bottom of which is seen the constricting band formed by the preputial ring which will show a

more or less deeply ulcerated surface corresponding to the length of time that the paraphimosis has lasted.

TREATMENT.—The prepuce must be drawn forwards, and this can be done fairly easily at an early stage before much œdema has been produced. The patient lies upon his back on a couch, and the surgeon places the fore- and middle fingers of each hand on either side of the organ behind the constriction (see Fig. 66). The thumbs are placed over the glans and gradually press it back through the preputial opening, which is pulled forward by the fingers behind it. If there is much œdema, a few punctures may be made with a fine tenotomy-knife in the œdematous fold in front of the constriction and the fluid allowed to escape. The whole procedure is very painful, and may require an anæsthetic.

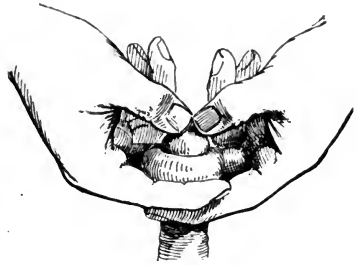


FIG. 66.—REDUCTION OF A PARAPHIMOSIS. This shows the position of the fingers behind the œdematous prepuce and also the way in which the thumbs are used to knead the glans back through the constriction.

The following manoeuvre may be useful in these cases. The penis is encircled from the apex of the glans to the root with a bandage of tape or narrow elastic webbing.

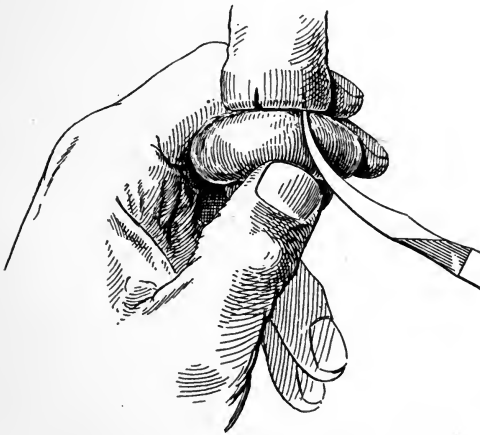


FIG. 67.—HOW TO DIVIDE THE CONSTRICTION IN PARAPHIMOSIS. The glans is well bent down so as to expose the constricting band, which is then nicked in two places, as shown in the figure.

This is applied especially firmly around the glans and the œdematous fold and is designed to drive out the fluid from the swollen end of the organ. It is kept on for two or three minutes, when it is quickly removed and the procedure recommended above for the reduction of the paraphimosis is carried out as rapidly as possible. The compression diminishes the size of the parts, and in this way the glans may be rapidly thrust back through the preputial ring.

When the swelling is very great, and especially when ulceration has occurred, this plan will not succeed, and the constricting band must be divided. The preputial ring is exposed by flexing the glans downwards (see Fig. 67); a sharp-pointed, curved bistoury is introduced beneath the ring on each

side of the middle line so as to avoid the dorsal vein of the penis, and the constriction is freely divided. The incision should go through the skin and subcutaneous tissues, and the prepuce can then be drawn forward with a little manipulation.

After reduction, the question of circumcision will arise, and in most cases this should be done at once, as the condition is very apt to recur, especially in children. When the constriction has been so tight that ulceration has occurred, circumcision is certainly called for, because contraction will follow the healing of the ulceration and the preputial ring will be tighter than before.

At the same time it is not always advisable to perform circumcision immediately after the reduction of a paraphimosis. In adults the accident frequently happens as a result of pulling back the prepuce in a case of balanitis in order to cleanse the glans; if circumcision were done before the balanitis is cured, serious septic mischief might result. In these cases, therefore, it will be best to wait for a few days until the balanitis has disappeared, and then to perform circumcision.

CHANCROID OR SOFT SORE.

Chancroid is an infective ulceration due to a specific bacillus, and generally occurs on the prepuce or glans penis. The affection is locally infective, and frequently leads to inflammation of the inguinal glands.

The result of infection is a local sore, which begins as a pimple a few hours after inoculation; this rapidly enlarges and ulcerates, and gives rise to other sores in its vicinity which extend rapidly, and may cause considerable loss of substance; when on the frenum, they may perforate or destroy it; when beneath the prepuce they may give rise to a good deal of œdema and phimosis or paraphimosis, and if no attention is paid to cleanliness, some sloughing of the surface of the wound may occur. The condition is quite distinct from syphilis, but the two diseases may be acquired simultaneously, and the soft sore may ultimately become indurated and secondary symptoms of syphilis develop. This possibility should always be borne in mind.

The inguinal glands quickly become infected, and those nearest the genitals enlarge and often suppurate; the suppuration is sub-acute, and is not accompanied by swelling of the surrounding parts—at any rate, in the first instance. Suppuration may occur in one gland after another, so that the illness may be a long and tedious one. When these abscesses are opened or burst spontaneously, the skin is frequently found to be undermined for a considerable distance; extensive chancroid ulceration may then occur in the groin and takes a long time to heal, and may cause widespread destruction of tissue. The organism causing the chancroid ulceration is said to be purely aerobic—a fact that may

explain the rapidly spreading ulceration that so often occurs after these abscesses have burst or have been opened.

TREATMENT.—When we bear in mind the serious results that may follow chancroids, and the length of time that the patient may be laid up and unable to follow his occupation, it is evidently important to endeavour to cut short the disease at as early a stage as possible.

(a) **Local.**—As soon as the diagnosis is made (and the chief point is to distinguish chancroid from herpes præputialis on the one hand, and from syphilis on the other), an attempt should be made to destroy the sore by caustics, of which the best is probably nitric acid. Care must be taken at the same time to prevent fresh infection of the surface, and for this reason it is necessary that the whole area should be completely exposed.

When there is no phimosis.—When the prepuce is not œdematous and can be readily retracted, it should be pulled back and the whole exposed surface washed with 1 in 20 carbolic lotion and subsequently with 1 in 2000 sublimate solution, especial attention being paid to the cleansing of the sulcus behind the corona glandis. The sores are then dried and a 10 per cent. solution of cocaine is applied to their surfaces. After a few minutes this is wiped off, and then the nitric acid is lightly applied by means of a glass rod or brush, or, failing that, a small piece of wood—such as a match. Great care must be taken not to let the acid run over the neighbouring mucous membrane. After allowing the acid to soak into the tissues for two or three minutes, it is neutralised by plunging the end of the penis into a saturated solution of carbonate of soda until effervescence ceases. The area should then be washed with warm sublimate solution, and moist boric lint laid over the glans; the prepuce is pulled forward over the lint so as to keep it in position, and the penis placed in a bag of boric lint. The prepuce should be retracted three or four times daily, the parts bathed with warm 1 in 2000 sublimate solution, the boric lint removed, and a fresh piece applied. As the sores heal, the lint need not be changed so often. When granulation is complete, the lint may be used dry until healing has occurred. The same treatment should be adopted when the sores are situated on the glans penis.

When there is phimosis.—When the prepuce is œdematous and cannot be retracted, there should be no hesitation in slitting it up so as to get free access to the sores. An anæsthetic is administered, and the parts beneath the prepuce are syringed out with warm 1 in 2000 sublimate solution. The prepuce is then slit up along the middle line upon its dorsal surface by introducing one blade of a pair of blunt-pointed scissors between it and the glans. The exposed parts are washed and cauterised in the manner just described. Gangrenous sores should be treated in the same manner, and if portions of the sore show signs of fresh infection as the slough separates, they should again be destroyed. If the gangrene is extensive and spreading rapidly, the actual cautery is better

than the nitric acid. In these cases the destruction of the affected parts must be carried out boldly; the best plan is to put the patient under an anæsthetic, clip away all sloughs and undermined skin, and then cauterise the whole area thoroughly, going wide of the disease both in its superficial area and in depth.

(b) **General.**—The patient must have nutritious diet, and should rest as much as possible, so as to avoid irritation of the inguinal glands. Violent exercise, or prolonged standing, should be prohibited. In the severer cases, rigid confinement to bed is necessary and quinine and iron may be given. The bowels should be kept open.

(c) **Of inflamed glands.**—As soon as signs of inflammation of the inguinal glands become evident, the patient should be put to bed and warm fomentations applied to the groins; if the primary sores are doing well, it not uncommonly happens that the glandular inflammation subsides. We do not advise the peri- and intra-glandular injection of carbolic acid and other substances advocated by some surgeons, as they are painful and generally inefficient. If it becomes evident, however, that suppuration is occurring, *excision* of the mass of glands, and the abscess in them, along with the surrounding fat, should be resorted to. It is not sufficient to shell out the enlarged glands alone, because the peri-glandular tissue may have become infected already. Care should be taken to cut wide of any abscess that may have already formed. By doing this, much time may be saved, and a long illness avoided, for if these abscesses are once allowed to open spontaneously, the surface may become chancroid, and healing is then slow, and is often further delayed by the formation of fresh abscesses in neighbouring glands.

After the skin has been shaved and disinfected, a free incision is made over the mass, the knife is carried through the healthy fat at some distance from the glands, and, after a little dissection, the whole mass is lifted out; should the skin be adherent, the infiltrated area of skin is enclosed in an oval incision and removed with the glands. After an operation of this kind it is well to insert a drainage tube at the outer angle of the wound and keep it in for a few days in case infection of the operation-wound should have occurred.

Sometimes, however, the case is not seen until a large abscess is present, and then the surgeon must content himself with making a small opening into it, inserting through this a small sharp spoon, scraping the wall of the cavity thoroughly, and washing it out. Some iodoform emulsion should be injected, and a small strand of horsehair or a shred of gauze laid between the edges of the wound, so as to allow of the escape of the discharge; outside the first layers of the dressing, pressure is made, either by sponges or a pad of gauze, kept in place by an elastic spica bandage; this brings the walls of the abscess cavity into contact, and helps to obliterate it. This plan is important, since the organism being aerobic, it is thus deprived of its due supply of air much more

effectually than if a drainage tube were inserted ; its growth is therefore more readily brought to a standstill. Great care must be taken in the antiseptic management of these cases, and the drain must not be left out until suppuration has entirely ceased.

When the abscess has burst and a chancroid surface is left, the skin around must be disinfected and the surface of the sore cauterised with nitric acid in a manner similar to that described for the primary sore. Afterwards cyanide gauze dressings and wool should be used until the ulcer has become healthy and superficial, when weak boric ointment may be substituted.

CHAPTER XXIV.

TRAUMATIC AND INFLAMMATORY AFFECTIONS OF THE PENIS.

INJURIES.

THESE are comparatively rare and take the form of contusions, punctured or incised wounds, hæmatomata or dislocation of the organ; the penis may also be strangulated by a ring passed over it or a ligature tied round it. Rupture, or so-called 'fracture,' of the penis may occur, and by these terms is usually meant the damage to the sheath of the corpora cavernosa, which results from a blow upon the erect organ. The importance of this injury is that erection may be interfered with subsequently by cicatricial contraction. By the term 'dislocation of the penis' is meant the rare injury in which the erectile portion of the organ has been dislocated from the skin and subcutaneous tissues, and has found its way into the cellular tissue elsewhere.

INFLAMMATORY AFFECTIONS.

BALANITIS.

The mucous surface of the prepuce is readily infected by pyogenic organisms, when balanitis, characterised by a purulent discharge between the glans and the prepuce, is set up. This may be due to the irritation of retained secretion beneath a long prepuce, to dirt, to masturbation, to venereal or herpetic ulceration, or to gonorrhœa. In most cases the surface of the glans is affected as well as that of the prepuce, and the term *postho-balanitis* has been applied to this condition.

The prepuce becomes swollen, and its orifice may be so narrowed by the œdematous swelling that a condition of acquired phimosis is present. Micturition is painful owing to the irritation caused by urine finding

its way between the glans and the prepuce. The surface of the glans when exposed is congested, and has lost its superficial epithelium in places, and sometimes is ulcerated. When the prepuce cannot be drawn back, the retention of discharge beneath it may give rise to extensive ulceration, ending in gangrene of the prepuce, or in lymphangitis and a general septic infection; this is most likely to occur when the affection is due to venereal sores.

TREATMENT.—When it is possible to draw the prepuce back, all that is necessary is to bathe the parts several times a day with warm boric or 1 in 6000 sublimate lotion, after which boric lint is tucked between the glans and the prepuce so as to prevent the opposed surfaces from coming into contact, and the prepuce is drawn forwards again. Under this treatment the inflammation will subside in a few days.

When, however, the prepuce cannot be retracted, the secretion beneath it must be removed by frequent copious syringing with warm boric lotion. If the prepuce is swollen and lymphangitis is present, the entire organ should also be wrapped up in lint saturated with lead lotion. Under this treatment the swelling and inflammation will generally subside, and then circumcision should be performed, especially when the prepuce is tight or long and the attacks of balanitis are of frequent occurrence.

When the inflammation persists or increases, the glans must be exposed freely, so that the parts may be thoroughly cleansed. The prepuce should be slit up by an incision on the dorsum, but it is better not to perform circumcision at this stage as the wound is septic and an obstinate circular ulcer may occur around the base of the glans. After the prepuce has been slit up, the glans is thoroughly cleansed and boric lint is inserted between the two; finally the whole organ is wrapped up in a large boric fomentation which must be frequently renewed.

HERPES PROGENITALIS.

Herpetic eruptions on the penis and prepuce are not uncommon; they are often associated with gout and also occasionally with stricture or with granular patches in the urethra. They may cause much distress, as the patient is likely to mistake them for venereal sores.

The condition begins with itching beneath the prepuce, on retracting which a typical herpetic patch is found on the glans or the inner surface of the prepuce. The vesicles run together and form a pustule which bursts and leaves a small ulcer sometimes difficult to distinguish from a soft chancre; the condition may not be noticed until it has lasted for some time, when balanitis may be present and the ulceration considerable.

TREATMENT.—The condition readily clears up under the treatment for balanitis (*vide supra*).

GANGRENE OF THE PENIS.

This is of very rare occurrence, and is practically always of the moist variety; the most usual causes are constriction of the organ by some unyielding substance—such as a ring or a ligature, very tight paraphimosis, or extravasation of urine following a calculus impacted in the penile urethra. It may also occur after specific fevers, such as typhoid or smallpox, and in connection with diabetes, alcoholism, or Bright's disease.

TREATMENT.—When the gangrenous patch is small and not spreading, the penis should be disinfected and boric fomentations applied until the sloughs have separated, after which skin-grafting may be required to cover the raw surface left. When the whole thickness of the organ is affected, it may be necessary to amputate the penis (see p. 274) well above the line of demarcation or to open the urethra in the perineum and establish a permanent opening in that situation.

INDURATIONS OF THE CORPORA CAVERNOSA.

Extensive localised indurations of the corpora cavernosa may be met with and lead to difficulty in erection or to lateral deflection of the organ, accompanied by much mental distress to the patient. These indurations may follow injury or be due to gummatous infiltration, but in most cases no cause can be traced. Microscopic examination shows an increase of fibrous tissue accompanied by endarteritis. Except for the local inconvenience, the condition is not serious.

TREATMENT.—Operative interference is useless in these cases, because the scar produces the same inconvenience as does the thickening, and, moreover, it does not check the spread of the induration. Good results may, however, be obtained by the use of radium; but in order to obtain these, 100 milligrams should be employed and kept in contact with the indurated patch for about eighteen hours.

CHAPTER XXV.

NEW GROWTHS OF THE PENIS.

THE only important growths affecting the penis are papillomata and epitheliomata.

WARTS.

These are common in connection with gonorrhœa ; they are probably not due to the gonococcus itself, but are caused by the irritating discharge. They also occur after frequent attacks of balanitis. Gonorrhœal warts are exceedingly common in the female, in whom they may cover the entire vulva ; in the male they may also be met with about the cicatrices of soft sores. The growths must be distinguished from condylomata, especially in the female ; this is readily done by noticing their pedunculated character, their characteristic papillæ, and the absence of any tendency to undergo ulceration.

TREATMENT.—The ordinary method of treatment is to snip off the warts. Single warts may be snipped off with a pair of scissors curved upon the flat, and the bleeding stopped by a nitrate of silver point. Small isolated gonorrhœal warts occasionally disappear if they are kept clean and dusted with equal parts of oxide of zinc, calomel, and starch, but removal with scissors is a quicker plan. When the area affected is very extensive and it is desirable to avoid leaving a large raw surface, the warts may occasionally disappear if they are kept dry and painted daily or every second day with salicylic collodion (100 grains of salicylic acid to the ounce of flexile collodion). Good results are also obtained in some cases by exposure to X-rays.

EPITHELIOMA.

Malignant disease of the penis is not uncommon, and it commences more frequently upon the glans than upon the prepuce. It usually begins in the sulcus behind the corona, but it may occur at the preputial ring.

Phimosis apparently plays an important part in the etiology of the affection, probably owing to the continued irritation of retained secretion. As a rule the growth is warty in character, and in the early stages is frequently confounded with a simple papilloma, whilst in the later stages it may be mistaken for a gumma; in other cases the tumour takes the form of a deep ulcerated crack with dense indurated margins. Any warty growth upon the penis in an old person should be looked upon with the gravest suspicion, and careful examination will usually reveal an induration of its base.

In doubtful cases no time should be wasted in keeping the patient under observation, but a portion of the edge of the growth should be removed for microscopical examination. The tumour is rapid in its growth and penetrates deeply into the glans; when once it implicates the corpora cavernosa it spreads rapidly through that structure. It may also spread into the corpus spongiosum and lead to difficult and painful micturition and ultimately to the formation of urinary fistulæ. The glands in the groin are affected early, very frequently on both sides.

TREATMENT.—The only treatment is amputation of the penis, and no time should be lost, as epithelioma in this situation frequently spreads rapidly. The amputation may consist in the removal of part or the whole of the organ. Partial amputation is suitable for those cases in which the disease is in its earliest stages, when the growth has not infiltrated the corpora cavernosa, and when it is possible to leave a projecting stump of the organ in front of the scrotum. If the amputation involves removal of the whole of the pendulous portion of the organ, the patient will be more comfortable if the whole organ is removed, and the urethra brought out in the perineum.

Partial amputation of the penis.—The parts are shaved and disinfected, and the penis is encircled by india-rubber tubing or by some suitable clamp applied immediately in front of the scrotum so as to arrest the circulation (see Fig. 68). The organ is then held in the vertical position and a full-sized straight bougie is passed down the urethra as far as the tourniquet. The best form of amputation is that by a long flap, fashioned from the skin of the under-surface of the penis, which must be long enough to cover the end of the organ comfortably, and should be slightly rounded, its length being rather more than half the circumference of the penis at the point of amputation. The flap consists of the skin and subcutaneous tissue, and can be readily raised by a few touches of the knife. The penis should not be put upon the stretch as the flap is cut.

After the flap has been raised and turned back, the two ends of the incision marking it out are joined across the dorsum by an incision slightly convex forwards, and then the knife, with its blade horizontal, is thrust between the corpora cavernosa and the corpus spongiosum, its cutting-edge is turned upwards and it is made to divide the corpora

cavernosa at right angles to the long axis of the penis on a level with the base of the flap. A few touches of the knife will suffice to separate the corpus spongiosum from the divided corpora cavernosa, and the former is divided half an inch in front of the base of the flap, cutting cleanly down on to the instrument in the urethra, which is then removed. A pair of catch-forceps is applied to the cut end of the urethra, the tourniquet is removed, and all bleeding is arrested. Bleeding vessels are generally found in the centre of each corpus cavernosum, while the dorsal artery of the penis will require ligature on each side, as will also those in the septum

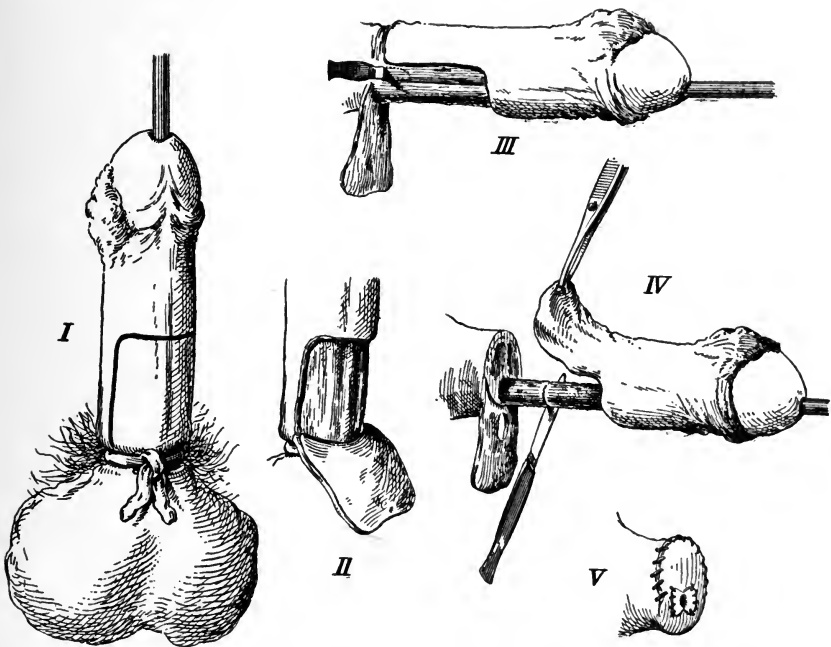


FIG. 68.—AMPUTATION OF THE PENIS. *I* shows the tourniquet applied, the catheter in position, and the flap marked out; this flap is reflected in *II*. In *III* the dorsal incision has been made and the knife is transfixing the organ between the corpus spongiosum and the corpora cavernosa preparatory to dividing the latter. This has been done in *IV* where a hole has been made in the flap for the urethra which is in the act of being divided. *V* shows the stump sutured.

between the corpora cavernosa; these may be difficult to seize and may require fine-pointed or 'mosquito' artery-forceps.

When the bleeding has been arrested, a small vertical slit is made in the centre of the flap, and through this the end of the urethra is drawn. The flap is now stitched to the skin on the dorsum, and the orifice of the urethra is secured to the aperture in the flap. It is necessary to see that this is larger than the normal calibre of the urethra, so as to allow for contraction during healing, and this is best done by slitting up the urethra for a short distance upon its upper and lower surfaces and carefully stitching the edges to the opening in the flap. If there is any oozing

from the cut surfaces of the corpora cavernosa a fine catgut drain may be inserted beneath the flap for a day or two. The best dressing is a large boric fomentation as for circumcision (see p. 263) ; the patient is allowed to micturate naturally.

One or two points must be carefully attended to in order to obtain a successful result. The first is that the relative positions of the skin and the body of the penis should not be disturbed—that is to say, the skin should not be drawn forwards when the flap is being fashioned, otherwise this will be too short. A second point is that all bleeding points must be arrested before the flap is sutured, otherwise union may fail. The third point is that the orifice of the urethra must be made more than full size so as to allow for subsequent contraction.

A flap from the under-surface of the penis is preferable to one from the dorsal surface, as the urine does not pass over the line of union when the patient micturates. The flap operation is far better than the ordinary circular amputation as there is less pain on micturition, healing is more rapid, and there is less contraction about the urethral orifice subsequently. The patient need not be confined to bed for more than two or three days. It is very rarely necessary to pass a bougie, but it should be employed if there is any tendency to contraction of the orifice.

Complete extirpation of the penis.—This operation is indicated when the disease is more extensive and definitely encroaches upon the corpora cavernosa. In cases of very extensive disease it is obviously the only possible operation, but in any case, it gives the patient a much better chance of non-recurrence than an amputation in front of the scrotum when the growth has invaded the corpora cavernosa. It is performed as follows : The patient is placed in the lithotomy position, the parts are shaved and disinfected, and an incision is made through the middle line of the scrotum, splitting it right down to the corpus spongiosum as far back as the bulbous urethra. A full-sized gum-elastic bougie is passed down to the triangular ligament in order to facilitate the recognition and isolation of the urethra in that position. The corpus spongiosum is now divided transversely about an inch and a half in front of the triangular ligament, isolated, and left hanging out of the wound whilst the rest of the operation is proceeded with. The bougie is removed after the urethra has been divided.

The incision splitting the scrotum is now carried up around the penis on each side in front of the scrotum, uniting over the dorsum of the organ and being prolonged up to the symphysis pubis over the suspensory ligament of the penis. The incision is gradually deepened, the two halves of the scrotum are drawn aside and the crura exposed to view. The incision along the dorsum is deepened up to the front of the symphysis pubis, the suspensory ligament of the penis is exposed and divided, and the dorsal vessels are secured. The crus penis is then peeled off from the pubic arch on each side, partly with a periosteum-detacher and partly

with the knife. When the crura have been detached, the entire penis is removed by a few touches of the knife. We are not inclined to perform castration simultaneously with the amputation, as some surgeons recommend, because of the serious psychological effects that may follow the operation.

After the bleeding has been arrested, a drainage tube is inserted at the anterior angle and the two halves of the scrotum are united by interrupted sutures of silkworm-gut, an interval being left at the posterior end of the perineal incision, to the sides of which the urethra is sutured. In order to prevent a stricture at the outlet, the urethra should be slit laterally on each side so as to make a small anterior and posterior flap which can be attached to the edges of the skin.

Gauze dressings are applied, and are kept in position by a T-bandage. The patient micturates spontaneously, the dressings being removed and renewed every time he does so. The functional result of this operation is often much better than that of the other method. The patient does not wet himself, whereas in cases of amputation just in front of the scrotum the urine is very apt to spray out and set up eczema scroti.

This operation may also be performed without division of the scrotum. The patient is placed in the lithotomy position and an incision made from the root of the scrotum to the central point of the perineum. This is then deepened and the posterior part of the urethra exposed and divided about an inch in front of the triangular ligament. This portion of the urethra is turned back and the corpora cavernosa are exposed by dissecting towards the sides of the incision. The branches of the internal pudic arteries going to the bulb and to the corpora cavernosa should be secured if possible before dividing them, and if this can be satisfactorily accomplished there will be very little hæmorrhage. The bulb and the crura are then freed from their attachments to the triangular ligament and pubic arch, so that the penis is attached merely by skin and by the fibrous tissue between the organ and the pubic symphysis. A circular incision is then made round the root of the penis, and, by putting a little traction on the organ, it can be removed with a few touches of the knife and without any further hæmorrhage. The posterior incision is then closed after attaching the urethra in the manner already described. The anterior incision can also be sutured, a small hole being left for the insertion of a drainage tube.

In all of these operations the glands in the groin should be removed either at the same time as the amputation—a proceeding which is to be preferred from the point of view of recurrence—or, subsequently, if it is feared that immediate removal would entail too severe an operation. All the inguinal glands, and also those along the femoral vein, should be taken away, together with the fat and fascia in the neighbourhood.

When infected glands extend into the iliac fossa, amputation of the penis is contra-indicated, except possibly when the local trouble is very

severe. In that case the object of the amputation is merely to get rid of the local disease and so allow the patient to micturate in comfort. In cases in which amputation of the penis is considered unadvisable, either owing to the extent of the disease or to other causes, the patient, if he suffers much on micturition, will be relieved by a median perineal section

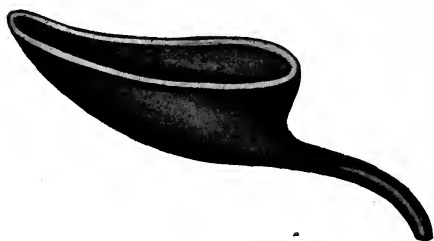


FIG 69.—APPARATUS FOR USE AFTER COMPLETE EXTIRPATION OF THE PENIS.

(see p. 348); it is a good plan in these cases to expose the urethra, divide it, and then isolate the proximal end and bring it out into the perineal opening. This will not only obviate passing urine over the surface of the growth, but will avoid any necessity for the use of a perineal catheter, as there is then no tendency for the

perineal wound to close; moreover, urine cannot find its way along the penile urethra to the growth.

After any of these operations in which the opening of the urethra is made in the perineum the patient may be provided with an apparatus (see Fig. 69) which consists of a sort of scoop to which is attached a short tube. It enables the patient to micturate standing up; he places the instrument between his legs and passes his water into it, the urine being carried away by the tube. It can be conveniently carried in an ordinary tobacco-pouch.

CHAPTER XXVI.

AFFECTIONS OF THE SCROTUM.

INJURIES.

WOUNDS.

THESE may be incised, punctured, or contused. They may be limited to the skin or they may extend deeply enough to expose the testis; the latter may be wounded or may protrude through the wound.

TREATMENT.—The skin of the scrotum is shaved and disinfected, any bruised tags are cut away, the wound is sponged over with 1 in 20 carbolic lotion and subsequently with 1 in 2000 sublimate solution, and the edges are brought together with fine interrupted catgut sutures; drainage should always be provided. Should the testis be protruding, it should be disinfected in the same manner and replaced. If the testis has been prolapsed for some hours, an acute hydrocele may have formed, and will require tapping before reduction can be effected; the parts should be thoroughly disinfected before the tapping is performed. The chief trouble in connection with wounds of the scrotum is the tendency for blood to accumulate in the loose subcutaneous tissue, giving rise to a large hæmatoma, which may not disappear for several weeks. For this reason great care must be taken to arrest bleeding completely, and also to provide free escape for blood by means of drainage tubes.

CONTUSIONS.

When these injuries are severe there is extensive extravasation of blood into the loose tissues outside the tunica vaginalis, and the name *scrotal hæmatocele* is sometimes given to this condition. In rare cases this hæmatoma may communicate directly with the cavity of the tunica vaginalis, in which there is then also a collection of blood. The usual causes of scrotal hæmatocele are blows or crushes of the part, or bleeding

from vessels which have been left unsecured in operations upon the scrotum ; it may also be found in newly born infants after a bad breech-presentation, and these cases are particularly important, as in them the soft parts are liable to slough.

The only difficulty in the diagnosis is to make sure that there is no hæmatocele of the tunica vaginalis. In scrotal hæmatocele the testicle, if it can be felt, moves independently of the swelling.

TREATMENT.—The patient should be put to bed with the scrotum supported on a small firm pillow or on the apparatus recommended for acute epididymitis (see Fig. 71). Lead and opium lotion should be applied, but an ice-bag should not be used unless bleeding is actively going on, as sloughing of the delicate scrotal tissues is liable to occur as a result of the cold. Should it be necessary to use cold, a double fold of lint should be interposed between the scrotum and the ice-bag.

When the effusion has become stationary, the scrotum may be enveloped in wool, outside which an elastic suspensory bandage is applied. The swelling often takes several weeks to disappear entirely, especially if the blood is actually within the tunica vaginalis ; should absorption be slow, recovery may be hastened by opening the collection of blood, turning out the clots, and inserting a drainage tube.

INFLAMMATORY AFFECTIONS.

ECZEMA SCROTI.

This may be merely part of a general eczema or may be set up by some direct irritation, for example, by parasites or by dribbling of urine, such as occurs in children with phimosis or stone, or in adults with stricture or enlarged prostate. The condition is common in gouty and diabetic subjects.

TREATMENT.—Any local cause must be remedied if present. When the parts are very irritable and weep freely, the patient should be kept in bed with the scrotum supported (see Fig. 71) and cold lotio plumbi continuously applied until the acute symptoms have subsided. The lotion may be iced if necessary, but opium should not be added lest dangerous absorption should occur from the raw surface.

After the acute symptoms have subsided, the use of diachylon or 20 per cent. ichthyol ointment or Lassar's paste is indicated, or dusting-powders composed of equal parts of oxide of zinc and starch, or of two parts of oxide of zinc, one of boric acid, and two of starch may be used. The insomnia, which is often troublesome in these cases, may be met by the administration of a draught containing syrup of chloral (3j), liq. morph. hydrochlor. (℥x), and bromide of potassium (gr. xx). Should this fail, recourse may be had to a suppository containing half a grain of morphine with a quarter of a grain of extract of belladonna. When

the affection is part of a general eczema, a stomachic tonic, such as rhubarb or gentian, should be administered in combination with a saline. Gout or diabetes must be appropriately treated.

ECZEMA INTERTRIGO.

This condition occurs on the scrotum in stout persons and young children as the result of chafing of the opposed surfaces of the scrotum and the thigh. It is treated by using a dusting-powder (see p. 280) and interposing a fold of boric lint between the opposed surfaces; in adults a suspensory bandage should also be worn.

ERYSIPELAS.

Scrotal eczema if neglected is apt to be complicated by septic infection, and the case may then become one of erysipelas or cellulitis or both. This condition may also occur in venereal disease or phimosis, in balanitis or in cases in which there is constant dribbling of urine. Grave and extensive cellulitis of the scrotum may result from extravasation of urine or from injection into the scrotum of irritants destined for the interior of a hydrocele sac. The gravest form of the affection occurs in the subjects of Bright's disease or diabetes.

The scrotum swells enormously, becomes red, tense, and shiny, and pits deeply on pressure. There is a special tendency for widespread sloughing to occur. The redness passes into a dusky lividity which rapidly goes on to gangrene.

TREATMENT.—This is similar to that for the affection elsewhere (see Vol. I. p. 197). Should it be necessary to make incisions into the tissues owing to sloughing or imminent suppuration, they should be very free; even should they expose the testes, no apprehension need be caused, as, when cicatrization occurs, it is rapid and complete, and the testicles soon become covered in.

ELEPHANTIASIS SCROTI.

This disease is rare in this country, and we can say little of it from personal experience. If the reader has occasion to deal with a case of this kind he should refer to the writings of those who have had special experience. Elephantiasis scroti is characterised by marked and persistent hypertrophy and cedema of the skin and cellular tissue; and is due to repeated attacks of congestion associated with obstruction of the scrotal lymphatics. In true elephantiasis this obstruction is due to the *filaria sanguinis hominis*, but in a few rare cases it appears to be due to inflammatory blocking of the lymphatic vessels; this may occur, for example, in tuberculous disease.

TREATMENT.—In the slighter cases it is sufficient to support and compress the scrotum firmly in a lace-up bag-truss. As the thickening advances, the weight of the tumour causes inconvenience, and the scrotum becomes enormously hypertrophied; until it may weigh half a hundredweight or more. Excision of the mass is called for under these circumstances.

In excising the hypertrophied mass, it is very important that all the affected part should be removed, while at the same time care must be taken not to damage the penis or the testicles. It is difficult to avoid injury to the penis, which lies buried at the bottom of a deep pit caused by the downward drag of the hypertrophied scrotum. The chief trouble in removing these hypertrophied masses is hæmorrhage. This may be temporarily controlled by an elastic ligature kept in position by long pins thrust through the scrotum on each side of the penis from behind forwards about the level of the commencement of the hypertrophy of the skin. The incisions must be planned so as to remove all the diseased area, but if possible enough skin should be left to cover the testicles.

At the commencement of the operation it is well to ascertain the position of the penis and to isolate it. When enough skin cannot be left to cover the testicles; Thiersch's grafts may be applied about ten days or a fortnight after the primary operation.

LYMPH SCROTUM.

In this condition the scrotal lymphatics are varicose, and there are frequently small vesicles on the scrotum discharging a fluid consisting of a mixture of lymph and chyle. The condition seldom requires surgical interference unless inflammation occurs in connection with it.

SYPHILIS.

Scrotal affections are not uncommon in the first two stages of syphilis. *Chancres* may occur in the primary stage and the scrotum is a common seat of *condylomata* in the secondary stage; many of the ulcers found on the scrotum in secondary syphilis are really ulcerating condylomata.

TREATMENT.—This is similar to that of the affection in general (see Vol. I. Chap XI.).

TUMOURS.

Tumours of the scrotum may be simple or malignant; the most common are sebaceous cysts, which need not be further referred to, and epithelioma, which is not an uncommon affection.

EPITHELIOMA SCROTI.

This disease has received the distinctive name of 'chimney-sweep's cancer,' but it appears not to be limited to this trade, as it occurs also in paraffin workers, and in others in whom the scrotum is liable to irritation from the material in which they work.

Chimney-sweep's cancer usually manifests itself as a small, hard, warty scrotal growth, covered with a firm scab, and increasing very slowly at first. It may be several years before it assumes active growth; but, however slow its early stages may be, a period comes at which it assumes the characters of an ordinary epithelioma, and it is then followed by rapid enlargement of the inguinal glands and general dissemination.

TREATMENT.—Early and free excision must be carried out as for malignant disease elsewhere; any suspicious warty surface on the scrotum should be removed freely even though there may be no history of rapid growth. The incision should be elliptical and go at least an inch wide of the base of the tumour in all directions; the whole thickness of the skin and dartos should be taken away. Castration may be necessary if there is any adhesion of the scrotum to the testis, but in ordinary cases this is not required. The inguinal glands on the same side as the tumour should be extirpated. There is nothing special in the treatment of this affection except to bear in mind that the apparently benign character of the growth in the early stages should not mislead the surgeon as to its true nature.

CHAPTER XXVII.

ABNORMALITIES IN THE DESCENT OF THE TESTIS.

ABNORMALITIES in the descent of the testis may be divided into two large groups, in one of which the testicle has not descended sufficiently far (*retained testis*), while in the other the organ has found its way into some abnormal position (*ectopia testis*).

RETAINED TESTIS.

The testis may be arrested in any part of its course from the back of the abdomen to the bottom of the scrotum; the condition may be unilateral or bilateral. When the testes have not passed out of the inguinal canal, the funicular process of peritoneum which descends with them is practically always open; and therefore the majority of cases are complicated by a congenital inguinal hernia. Even when a hernia is not actually present at first it is always liable to occur later on. When the testicle has not reached the scrotum, that side of the scrotum is usually imperfectly developed.

Undescended testes are seldom developed properly, and some hold that they are functionless when they lie in the inguinal canal; this, however, is not definitely proved, and in any case it would appear that if they are brought down into the scrotum sufficiently early in life they may grow and become active.

When the testicle is retained in the inguinal canal, various abnormal conditions may arise. Besides the possibility of becoming functionally useless, the testicle is liable to attacks of acute inflammation not only from causes that give rise to a similar condition in the normally placed organ, but also from the pressure to which the displaced organ is subjected, and from the greater liability to injury from sudden movements—such as violent flexion of the hip-joint and blows or kicks on the groin. There is, moreover, a special tendency for the testis to undergo partial or complete torsion, so that the cord becomes twisted and the organ may have its blood-supply so gravely interfered with that it becomes gangrenous.

When torsion of the testis takes place and gangrene occurs, peritonitis is apt to follow. Any attack of inflammation of the testis in this region is serious, and not only is there great pain and constitutional disturbance, but the affection is frequently mistaken for astrangulated hernia. Hydrocele and hæmatocele are not uncommon complications, and it is also said that a retained testis is more liable to become the seat of malignant disease than a normally placed one.

TREATMENT.—The foregoing facts indicate that when the testicle lies in the inguinal canal it is always advisable to remove the organ from its abnormal position. *Palliative treatment* is of little avail. The old plan of applying a truss with a horseshoe-shaped pad so as to occlude the inguinal canal after the testis had been pulled down beyond the external ring and so prevent it going back, has little to recommend it. The hernia practically never becomes cured, neither does the testis descend into its normal position in the scrotum. Indeed, the presence of a hernia is rather an advantage than otherwise—as far as the descent of the testis is concerned.

The only rational treatment is by *operation*, and this may have one of three aims : (1) to bring the testis into the scrotum ; (2) to replace it in the abdominal cavity ; or (3) to remove it altogether. The points influencing the decision as to which of these methods should be employed are mainly the condition of the testis, its situation, and the length of the structures forming the cord. When the patient is seen soon after birth, it is perhaps best to delay the operation until the child is about four years old—that is to say, until he is intelligent enough to avoid wetting the dressings ; there is no urgency about these cases. Should a congenital hernia be present and should the child be under constant medical supervision, it is best not to employ a truss, as the hernia can always be cured at the time the operation on the testis is undertaken, and the protrusion of the hernia not only helps to stretch the cord, but also pushes down the testicle in front of it, and may lead to the development of a cavity in the scrotum into which the testis is afterwards placed ; it thus materially helps the success of the subsequent operation. If the child is under observation, any sign of strangulation will be noticed at once, and the necessary measures can be taken.

Orchidopexy, or *bringing the testis into the scrotum*.—One difficulty in connection with bringing the testicle into the scrotum is the imperfect development of the latter. This is most marked when both testicles are imperfectly descended, for when the testes are brought down to the bottom of the scrotum, the elasticity of the dartos tends to squeeze them out again. Another difficulty is the shortness of the tissues forming the cord ; in this connection it is important to remember that when the testis has descended to the neighbourhood of the external ring, the vas deferens itself is always long enough. The tissues that are unduly short are the vessels and the fibrous structures. If these were all divided, the organ

could no doubt be brought down satisfactorily, but some vessels and nerves must be left, otherwise the testicle would not develop and might die. The funicular process of the peritoneum must also be most carefully separated from the structures of the cord as low down as the epididymis, and this is often a difficult matter as the process is very thin and the elements of the cord are closely adherent to it.

The usual incision for the radical cure of an inguinal hernia is employed (see Vol IV. p. 489), and the external abdominal ring is exposed. The external spermatic fascia is divided, the aponeurosis of the external oblique is slit up, and the testis with the hernial sac and the structures of the cord are lifted out of the inguinal canal and cleared as far as the internal ring. The vas is then isolated and the hernial sac identified, carefully peeled off the structures of the cord, and cut across immediately above the epididymis; the upper end is cleared well up to the internal abdominal ring and clamped pending the treatment of the testis. In clearing the sac it must be borne in mind that the vas often runs down below the testicle, and is very apt to be injured or divided unless special care be taken. The testis is now pulled downwards towards the scrotum so as to put the tissues of the cord on the stretch, and to ascertain which of them prevent the testicle from coming into the scrotum. The bands of fibrous tissue and the cremaster muscle must be divided, together with any other structures that will not stretch sufficiently to allow the testis to be brought into the scrotum. As many of the blood-vessels should be saved as possible, but as a rule the vessels and nerves which accompany the vas are sufficient to prevent necrosis or atrophy of the testis. When these structures have been divided, the parts will usually be sufficiently elongated to enable the testis to be brought down to the bottom of the scrotum without undue tension on the cord. If there is any difficulty in getting the testis quite to the bottom of the scrotum, additional length will be obtained by separating the vas deferens, the globus minor, and the body of the epididymis from the body of the testicle, and then pulling the latter down.

When the cord has been sufficiently elongated, the finger is pushed down into the corresponding half of the scrotum and a pouch is made for the reception of the testis. A silk ligature of medium thickness is then threaded on a *nævus*-needle and passed through the tissues and the tunica albuginea at the bottom of the testis, well free of the globus minor, and the needle is unthreaded. Both ends of the stitch are now threaded through the eye of the needle, which is then passed down through the bottom of the pouch made in the scrotum, under the guidance of the finger. The needle is then unthreaded and the two ends of the stitch are left protruding from the bottom of the scrotum. Traction upon the ends of this thread will pull the testis well down into the bottom of the scrotum and put all the structures upon the stretch. When this is being done, care must be taken to see that the testis is not twisted upon the vas. The

ends of the ligature are caught in clamp-forceps and given to an assistant to hold, whilst the surgeon finishes the radical cure of the hernia, which should be done on the lines laid down in Vol. IV. p. 489. The wound is closed and a collodion dressing applied, outside which a larger gauze dressing may be prolonged down to the lower end of the scrotum.

The final, and very important, step is to arrange that the testicle shall not slip up again, and for this purpose the wire frame shown in Fig. 70 has many advantages over the older plans of stitching the scrotum to the thigh. The frame is made of moderately soft wire and can be moulded to fit the individual patient. It is fastened on outside the dressing by means of tapes, one of which extends from each side of the base of the frame around the body between the crest of the ilium and the great trochanter, whilst two tapes are fastened to the apex and pass up on each side in the folds of the buttock to the tape around the waist; when these are tied, the transverse bar lies immediately below the bottom of the scrotum. The ends of the silk ligature are now passed around the bar, tightened up, and tied in a bow. This keeps the testis down in place with the scrotum stretched over it, and there is no chance of its receding as long as the stitch holds. Extra dressing is applied outside the apparatus.

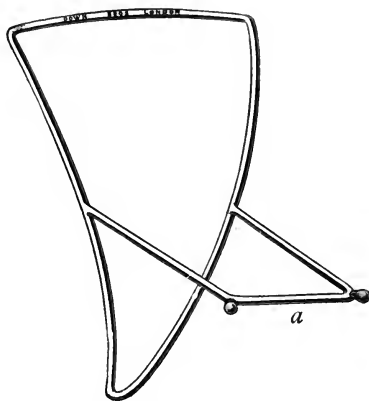


FIG. 70.—WIRE FRAME FOR USE IN ORCHIDOPEXY. The thread passing through the bottom of the testis is fastened to the bar, *a*. The base of the triangle lies over the symphysis, the apex is in the perineum.

The dressings are changed in about five days, when the skin stitches may be taken out and the traction thread tightened up so as to pull the testis a little lower down; it may be tightened again at intervals of two or three days until it cuts its way through. If it has not given way before three weeks have elapsed, one end may be cut close to the scrotum, the thread pulled out and the minute aperture covered by collodion.

The result of pulling on the testis in this manner is to stretch the structures of the cord as well as the scrotum; moreover, the cord becomes fixed in the cicatricial tissue and the testis does not retract. Very good results have followed this method, the testicle increasing in size and obviously developing. Even should full success not be obtained, and should the testis retract to the upper part of the scrotum, it is still outside the inguinal canal and in a position in which it is free from injury, and may undergo development. This partial recession may occur when the descent of both testes is defective, and both sides of the scrotum

are therefore undeveloped ; even here the improvement is great, and the attempt should always be made in preference to performing castration.¹

Replacement of the testis within the abdomen.—When it is impossible to bring the testis down into the scrotum, this operation may be performed, especially when both testes are undescended and are apparently normally developed and when they are painful.

Any hernial sac present is isolated as before, and then the question arises as to whether the testis should be returned within the peritoneal cavity or should be placed in the sub-peritoneal tissues. The latter is the natural position because the organ would have to pass through a slit in the peritoneum if it were returned inside the peritoneal cavity, and the cord might be constricted and the development of the testicle interfered with. The best plan is to separate the peritoneum from the tissues outside it for some distance backwards towards the iliac fossa and to place the testis in the cavity so formed. The opening in the peritoneum is then closed and the operation for radical cure completed in the usual manner, the inguinal canal being completely closed. When only one testicle is undescended it is better to remove it, as it is doubtful whether it will develop in this position, and it may subsequently become inflamed or the seat of a new growth.

Castration.—This operation may be called for : (1) In adults when the testis is small, obviously of no value, and accompanied by a hernia. Removal of the testis will greatly facilitate the completeness of the radical cure, as the entire canal can be sewn up without room having to be left for the cord. (2) It may be necessary in young subjects who have suffered from repeated attacks of inflammation, as this is almost certain to prevent development of the testis. (3) It is also called for when gangrene threatens or actually exists—as, for example, after torsion of the cord. (4) It is obviously indicated when the organ is the seat of tuberculous or malignant disease.

The early stages of the operation are similar to those just described, but instead of the testicle being preserved, the cord is clamped and divided at the level of the internal ring, and the lower part of it and the testis are removed. The radical cure of the hernia is then completed in the usual manner (see Vol. IV.).

Treatment of complications.—We have already discussed the treatment of the *hernia* with which most of these cases are complicated. In *inflammation* of the retained organ it is well to wait for the inflammation to subside before proceeding to radical treatment, and then if the attacks have been severe or repeated, castration, followed by complete closure of the inguinal canal, will be the operation chosen. If the inflammation is very severe the surgeon may deem it advisable to remove the testis without waiting, and, besides, it sometimes happens that a retained testicle is cut down upon under the impression that the case

¹ See *Med. Society's Transactions*, vol. xiii. p. 497.

is one of strangulated hernia. If this is the case, the best plan is to complete the operation by removing it. When *torsion of the cord* has occurred or *gangrene* has set in, the proper procedure is immediate castration.

ECTOPIA TESTIS.

Here the testis, instead of passing from the inguinal canal into the scrotum, finds its way elsewhere. The chief forms of this condition are *perineal ectopia*, in which the testis misses the entrance into the scrotum and passes into the perineum, and *crural ectopia*, in which the testis, instead of leaving the abdomen by the inguinal canal, passes through the crural ring and either lies in the crural canal or turns up on to the thigh over the lower part of Poupart's ligament after passing through the saphenous opening. *Pubic ectopia* is sometimes, but very rarely, met with; in it the testis lies in front of the pubic spine near the root of the penis. Another form occurs when the external ring is completely closed and the testis, being prevented from reaching the scrotum, passes outwards and lies between the oblique muscles just below the anterior superior iliac spine.

In all cases of ectopia testis the corresponding half of the scrotum is ill-developed. The testicles, however, are usually well developed and functionally active. Crural ectopia is the form most likely to be associated with hernia.

TREATMENT.—As the testis is subject to injury in these abnormal positions, it should always be placed in the scrotum if possible, and this is generally comparatively easy except in the femoral form.

In **perineal ectopia** an incision is made just over the external ring, the cord is exposed, and the testicle is pulled up from its bed in the perineum. If it is adherent, the remains of the gubernaculum testis may have to be divided. A passage is then made with the finger from the external ring to the bottom of the scrotum, and the testis is secured in place by the means described on p. 287.

In **femoral ectopia** the treatment is more difficult. The testicle may be so well developed that it is impossible to get it back through the crural canal without enlarging the crural ring, and the question will arise as to whether castration should be performed. The decision will be influenced largely by the liability of the testicle to injury in its abnormal position, and also by the condition of the one on the opposite side. If the other testicle is normal and in the scrotum, and if there is a history of attacks of pain and inflammation in the ectopic testicle, castration should be performed, and a radical cure done if a femoral hernia is present. If, on the other hand, the other testicle is imperfect, the surgeon will hesitate to perform castration, and will not do so unless there is a history of repeated attacks of orchitis.

When the testicle merely lies in the crural canal, the organ can be replaced in position by opening up the inguinal canal, pulling the testis out of the crural canal, and placing it in the scrotum in the manner recommended for an imperfectly descended organ. The crural canal will then be closed in the usual manner (see Vol. IV. p. 496).

CHAPTER XXVIII.

INJURIES AND INFLAMMATORY AFFECTIONS OF THE TESTIS.

INJURIES.

THE treatment of punctured or incised wounds of the testis is similar to that of wounds in general.

CONTUSIONS.

When the testicle is bruised, hæmorrhage occurs beneath the tunica albuginea ; if much blood is effused and cannot escape, complete atrophy of the testis may follow. After the accident there is rapid swelling of the organ, accompanied by intense pain, some collapse and nausea. In bad cases the pain is so severe as to cause the patient intense agony. In some cases the tunica albuginea may be split and the testicular substance may bulge out through the rent, and blood may accumulate in the tunica vaginalis and form a hæmatocele.

TREATMENT.—In slight cases the application of iced lotions or an ice-bag may be sufficient; but if there is much extravasation it is essential to allow the blood to escape in order to avoid atrophy of the testis. This is readily done by means of an incision through the tunica albuginea, made by a tenotomy knife introduced through the scrotum over the body of the organ. This allows blood-clot or oozing blood to escape, and healing is rapid. When a hæmatocele is present, and persists, it should be opened up (see p. 319), and if a rupture of the tunica albuginea is present it may be stitched up with catgut sutures.

LACERATED WOUNDS.

When a lacerated wound of the scrotum involves the testis, the best treatment in most cases is to remove the organ at once, as the testis

will in all probability be hopelessly injured. Moreover, sepsis will probably be avoided by proceeding at once to castration. The contused edges of the wound in the soft parts should be excised at the same time.

TORSION OF THE SPERMATIC CORD.

A number of cases have now been operated upon in which the cord has been twisted to such an extent that the blood-supply to the testis is cut off and gangrene occurs; this is especially likely to occur in an imperfectly descended testis when the organ hangs into the tunica vaginalis in a horizontal position and when therefore it is easily rotated around its transverse axis. The accident usually follows a blow or strain, and gives rise to much shock, accompanied by vomiting, tenderness, local pain, and rapid swelling in the region affected. The condition may be mistaken for strangulated hernia.

TREATMENT.—The best plan is to remove the testis. Cases have been published in which the condition has not been very severe and the twist has been undone. The occurrence of the twist may be recognised from the position of the epididymis, which comes to the front or the outer side, instead of lying behind and to the inner side.

INFLAMMATORY AFFECTIONS.

The epididymis, or the body of the testicle, may be the seat of the inflammation, or both may be affected simultaneously. The inflammation may be acute or chronic, the latter form being especially associated with tubercle or syphilis.

ACUTE EPIDIDYMITIS.

This affection usually originates in connection with some inflammation in the deep urethra, and although it is sometimes met with apart from a gonococcal infection, this disease accounts for the vast majority of the cases. When due to the gonococcus, it generally sets in during the third or fourth week of the gonorrhœa; before the attack occurs, there are signs that the inflammation has reached the deep urethra (see p. 352). Any other acute urethral inflammation may also set up an acute epididymitis. It is not uncommon in patients with enlarged prostate who lead a catheter-life. It may also occur in connection with inflammation behind a stricture, with prostatic or impacted urethral calculi, and after operations such as prostatectomy, urethrotomy, lithotomy, or the passage of urethral instruments. It is rarely of non-urethral origin, but it may occasionally follow an injury,

and may possibly be due to gout. The affection seldom goes on to suppuration when it is gonococcal in origin, but suppuration is not uncommon when it is due to other causes.

Tenderness and thickening generally occur along the vas deferens before the epididymis shows signs of inflammation, because the infective organisms pass along the vas or in the lymphatics in its wall, on their way to the epididymis. This is soon followed by swelling of the epididymis, which surrounds the body of the testis like a horseshoe and is hard and extremely tender; the body of the testis itself is unaffected. There is often an acute hydrocele, and the scrotum may be red and œdematous. The pain is very acute when the patient is standing with the testis unsupported, but is considerably less when he lies on his back with the scrotum elevated. The pain extends up into the groin along the course of the cord, and all the symptoms of acute inflammation are present.

The ordinary gonococcal form of epididymitis generally reaches its height in four or five days and then subsides, and the patient is free from pain in two or three weeks, according to the severity of the attack. The inflammatory thickening of the epididymis passes off more slowly and a hard nodule may remain there for an indefinite period; this induration is important, as the vas usually becomes occluded by it, and the patient may become sterile should both testes be affected. The testis, however does not undergo atrophy, nor do any of the general symptoms associated with castration (see p. 302) appear. After coitus, the epididymis may swell up from the accumulation of seminal fluid, and may cause pain, but otherwise no ill effects seem to follow.

TREATMENT.—The objects of the treatment are to subdue the inflammation as quickly as possible and to get rid of the inflammatory exudation. The patient should be kept on his back with the scrotum raised and supported. One of the best methods of doing this is to take a piece of guttapercha, poroplastic material, or thick millboard, about eighteen by twelve inches, and to cut a semicircle on one side, large enough to embrace the root of the scrotum (see Fig. 71). Holes are bored at each end of the side from which the semicircle is cut, and through these tapes are threaded by which the apparatus can be fastened to a band round the waist, and so adjusted that the semicircle embraces the root of the scrotum, and the testicles rest upon its upper surface with a piece of lint or wool interposed between them and the splint. The knees are tied together, and the under-surface of the apparatus rests upon the thighs, which are slightly raised; the shoulders should be kept low. In this way the testicles are elevated and immobilised, and the pain soon diminishes.

The best local application in the first instance is cold, either by an ice-bag or by Leiter's tubes (see Vol. I.). Little pressure can be borne, and therefore the ice-bag should be suspended from a cradle, and a double

layer of lint applied between it and the scrotum. If the cold is too great there will be slowing of the circulation, and the scrotum becomes blue, and if the application is continued gangrene may occur; to avoid this, the application should be intermitted every few hours for an hour or two. When the inflammation is not very acute, sufficient cold may be obtained by the application of ordinary evaporating lotions (see Vol. I. p. 9). Cold is only of value for the first two or three days.

In some cases the pain is so intense that cold fails to relieve it, and then more benefit will be obtained from hot fomentations. A piece of mackintosh the same size as the support upon which the testicles lie (*vide infra*) is placed beneath the scrotum, and the fomentation is laid over the front of the testicle; the mackintosh is then folded over so as to cover the fomentation, and a mass of hot cotton-wool is applied outside

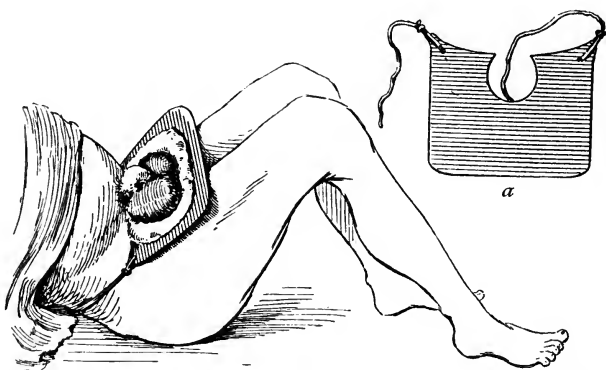


FIG. 71.—SUPPORT FOR THE TESTES IN ACUTE EPIDIDYMITIS. The shape of the support is shown in *a*. The larger figure shows its method of application.

and fastened on by a bandage. Fomentations are especially valuable when suppuration is occurring, but on the whole cold is probably more effectual in arresting the inflammation, as it acts directly on the vessels of the cord; it should therefore always be tried first.

The venous congestion may be relieved by a brisk saline purge and by keeping the bowels freely open. When the inflammation is very severe, benefit may be obtained by the use of leeches, but there is always some risk in employing them, as it is difficult to arrest the bleeding from the scrotum afterwards; it is better to apply them over the external abdominal ring than over the scrotum. When the inflammation is extremely acute, an even better plan is to disinfect the skin of the scrotum and to open two or three of the distended scrotal veins with a scalpel. Bleeding is then encouraged by applying hot fomentations, and there is no difficulty in arresting the oozing.

It will generally be necessary to administer morphine to relieve the pain and to check the restlessness that is associated with the inflammation

and the maintenance of the dorsal position. The morphine is best given in half-grain suppositories, to which may be added a quarter of a grain of extract of belladonna. Occasionally, benefit may be obtained by the administration of ten-grain doses of salicylate of soda three or four times daily. The patient should be kept on a light semi-fluid diet.

As the inflammation subsides, the scrotum may be enveloped in lint thickly spread with glycerinum belladonnæ, outside which is applied a large mass of cotton-wool kept on by a lace-up bag. Compression must be employed very carefully because it may do harm if it is begun too early, and special care must be taken to see that the bandage is not drawn so tightly above the testis as to interfere with the circulation.

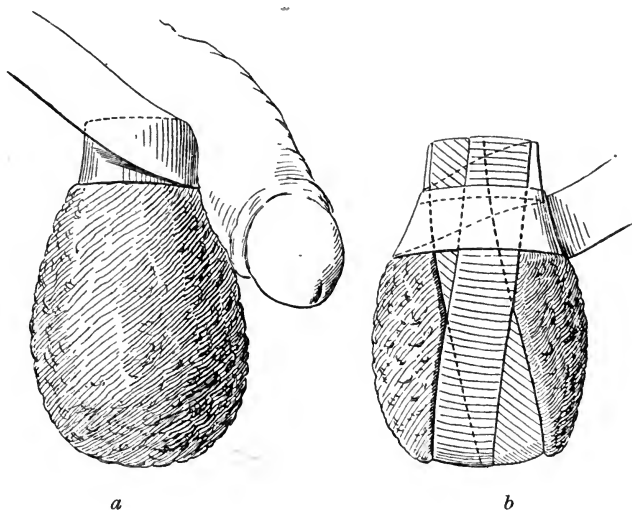


FIG. 72.—STRAPPING THE TESTICLE. The isolation and preliminary fixation of the testicle is shown in *a*, where a horizontal turn of strapping is taken round the root of the scrotum. The method of applying the strips of strapping alternately vertically and horizontally is seen in *b*.

In a fortnight or three weeks the pain and tenderness will have disappeared, leaving a hard mass in the epididymis, and at this period firm compression is useful in causing absorption of the inflammatory exudation. The old plan of strapping the testicle is very valuable. The scrotum is shaved and cleansed, the affected testis is isolated from its fellow, and a narrow strip of boric lint is wound around the scrotum above it. Over this a strip of strapping is applied circularly and tightly enough to prevent the testis from slipping up through it, and then a series of alternate vertical and horizontal strips is applied, as shown in Fig. 72, until the whole organ is covered in. The strapping is applied as firmly as the patient can bear, and should be worn for two or three days and then renewed. It should be continued until all the thickening has

disappeared from the epididymis. The patient may then wear a suspensory bandage, or, still better, a pair of triangular bathing-drawers fitting quite tightly, with a pad of wool to keep the testicles in contact with the abdominal wall, and may be allowed to walk about.

When a patient has had one attack of acute epididymitis, he is apt to get another should he again contract gonorrhœa, and special care must be taken under these circumstances to keep the testes supported and free from injury from the commencement of the attack.

An important question is the treatment of the exciting cause in gonococcal epididymitis. It is found that the urethritis diminishes and the discharge may disappear during the height of an acute gonococcal epididymitis; as the inflammation in the testicle subsides, the discharge returns. It is inadvisable to irritate the urethra during the acute stage of epididymitis, but, as soon as the acuter symptoms are subsiding, the gonorrhœa should be treated vigorously on the lines laid down on p. 353. Similarly, when the inflammation occurs in connection with a stricture or an enlarged prostate, steps should be taken to treat the cause as soon as the acute symptoms subside, otherwise recurrence may take place with serious results to the testis.

ACUTE ORCHITIS.

Inflammation of the body of the testis is less frequent than inflammation of the epididymis. It may follow an injury when blood becomes effused beneath the tunica albuginea, and it may also occur in connection with gout or rheumatism; it is not infrequently met with during the course of specific fevers—such as mumps, typhoid fever, smallpox, scarlet fever, or influenza. In these circumstances it may be accompanied by supuration; this, however, is rare in mumps.

The symptoms of acute orchitis are somewhat similar to those of epididymitis, except that on examination the body of the testis is enlarged and tender whilst the epididymis is hardly distinguishable. There is, moreover, not the same tendency to acute hydrocele.

The prognosis of acute orchitis is more serious than that of epididymitis, as the acute inflammatory affection of the body of the testis is apt to be followed by atrophy of the organ. This is especially common after mumps; both the generative function of the testis and also its other functions may be destroyed, so that if the condition is bi-lateral, psychological symptoms, similar to those following double castration (see p. 302), may arise.

TREATMENT.—The treatment of acute orchitis should be on lines similar to those for acute epididymitis, except that the testis need not be strapped. If the pain is severe, great relief can sometimes be afforded by incising the tunica albuginea. This is best done under a general anæsthetic, and nitrous oxide will usually be found sufficient. A tenotomy knife is

thrust through the scrotum, and the tunica albuginea is incised for about an inch downwards from the globus major; care should be taken to avoid injuring the epididymis. In some cases several small stab-wounds into the testicle will be sufficient. The exudation which remains in the body of the testis after the acute attack is smaller and less persistent than that met with after acute epididymitis. In acute orchitis, however, the surgeon not infrequently has to deal with suppuration, which is uncommon in epididymitis.

The onset of suppuration may be inferred when the temperature is high and irregular, the pain continues in spite of rest, the swelling increases, and the oedema of the scrotum becomes more marked. Should pus form in the epididymis, a fluctuating spot soon betrays the existence of an abscess, but in orchitis it is often a long time before the tunica albuginea softens sufficiently to allow the abscess to come to the surface. As soon as the existence of an abscess is certain, it should be evacuated, and, as a rule, healing occurs without a hernia testis. Occasionally, however, it will be necessary to perform castration—especially in cases of septic inflammation of the body of the testis with numerous small scattered abscesses—both because evacuation of one abscess may not relieve the others and also in order to avoid the risk of general septicæmic infection. Under these circumstances the best plan is to divide the cord above the scrotum, and remove the whole of the affected area along with the testicle without opening the abscess.

CHAPTER XXIX.

TUBERCULOUS EPIDIDYMITIS AND ORCHITIS.

TUBERCULOUS disease of the epididymis and testicle is a comparatively common form of genito-urinary tuberculosis. The disease may be primary in the epididymis, but it is often associated with tuberculous disease in other parts of the genito-urinary system. The vesiculæ seminales on the affected side become enlarged at an early period, and distinct thickening of the vas deferens may also be present. The early enlargement of the vesiculæ seminales is an important diagnostic point, and when this is absent in chronic cases the great probability is that the disease in the epididymis is not of a tuberculous nature.

Tuberculous disease of the epididymis and testicle may be general or local. The general form occurs in the course of an acute general tuberculosis, and it is not necessary to refer to it. There are two forms of the local disease: the one, an acute form, which may begin in the testicle, and the other, a more chronic form, which commences in the epididymis and only affects the testicle secondarily. The acute form is quite rare and generally begins with a deposit of tubercles in the inter-tubular tissue of the testicle, which subsequently spreads to the epididymis; the process rapidly leads to destruction of the testicle.

Usually the disease begins in the epididymis; sometimes its course is quite acute, but more frequently it is chronic from the first. The affection is only limited to the epididymis in the early stages; the vas soon becomes thickened and the vesiculæ seminales enlarged. The prostate also is not infrequently involved, and the disease may spread upwards as an ascending genito-urinary tuberculosis.

It is still a matter of dispute as to which portion of the epididymis is first affected; probably the affection commences most often in the globus minor. The tubercle bacilli may be deposited either in the interior of the spermatic duct or in connection with the vessels around it, and the disease quickly involves the whole epididymis, and extends not only up along the vas, but also into the body of the testis itself. In the testicle the tubercles are first found in the intertubular tissue in

the corpus Highmoriani; isolated nodules may also be present at a later period.

The disease is generally unilateral at first. As a rule, however, the other side is ultimately attacked, but usually only after an interval of some months and often of some years. The disease in the second testicle is often more acute than in the first, and therefore it is most important to try to save the body of the testicle first affected, because very serious psychical results may follow the loss of both testicles.

From the point of view of treatment the cases may be divided into three groups: acute tuberculosis of the testicle and epididymis; the ordinary sub-acute or chronic tuberculous epididymitis; and tuberculous epididymitis accompanied by suppuration or sinus formation. The choice of the method of treatment will also depend on whether the disease is unilateral or bilateral.

In very acute cases the disease begins without any apparent cause, or it may follow a gonococcal or other form of epididymitis. In the latter cases, the pain and swelling increase, instead of subsiding as in an uncomplicated gonococcal infection, abscess occurs rapidly—often within six weeks—and the vesiculæ seminales and cord soon become enlarged. Occasionally, the body of the testis alone is affected primarily, the epididymis being free; the pain is then very acute.

The ordinary sub-acute or chronic tuberculous epididymitis varies much in the rapidity of its course and the severity of the symptoms.

There is usually some pain at the commencement of the disease, but it is seldom severe and is generally intermittent and of a dragging character, the chief complaint being of a feeling of weight and fullness in the testis. The gland is tender on pressure and the vas is generally, although not invariably, thickened.

The enlargement of the epididymis generally reaches its full extent in a few weeks, and then remains stationary for a considerable period unless an abscess forms. The swollen epididymis forms a characteristic horseshoe-shaped enlargement, partially embracing the testicle, and is largest at the globus major. Abscess formation is common, and its occurrence is marked by an increase in the subjective symptoms, especially the pain; eventually, sinuses form, leading down to the epididymis.

TREATMENT.—(a) **Of acute tuberculosis.**—The only treatment that offers any prospect of success is immediate castration. Unless, however, this is done quite early, the disease is almost certain to spread to the rest of the genito-urinary system, and in performing the operation it is most important to divide the vas deferens as high up as possible (see p. 301).

(b) **Of sub-acute and chronic tuberculosis.**—The treatment of these cases, like that of most other tuberculous lesions, may be considered under the headings of non-operative and operative measures. A considerable number of cases of tuberculous epididymitis become

quiescent either without suppuration or after suppuration has occurred, and after a time the thickening may disappear almost entirely. It is, however, extremely difficult to say in any given case that this is likely to happen. In the acute, rapidly breaking-down forms—especially those affecting also the body of the testis itself—it is fairly certain that the disease will not become quiescent, but in the more chronic cases, in which a firm and painless swelling has been found accidentally in the first instance, one can never be quite certain; some cases improve steadily under general treatment, whilst others, which at first looked equally promising, break down and suppurate.

Non-operative.—If the case is quite chronic when first seen, expectant treatment may be employed, especially when there is tuberculosis elsewhere in the genito-urinary system and when the local lesion has apparently a tendency to recovery. This consists essentially in placing the patient under the best hygienic conditions, supporting the testis well, and guarding it from injury. The *general treatment* is that for tuberculosis in general (see Vol. I.). In the *local treatment* belladonna ointment may be employed if there is much pain, while, if not, the testis should be supported by a suspensory bandage, and may be lightly strapped with simple strapping (see p. 295) or with mercurial ointment; it is, however, doubtful whether the latter exerts any beneficial effect. The injection of iodoform and glycerine or of chloride of zinc into the epididymis, which has been recommended, does not appear to be of any special value.

Operative.—Formerly, this usually took the form of castration, but in more recent years less severe operations have been employed with success. This is particularly the case with the operation called epididymectomy, which aims at removing the disease by excision of the epididymis and cord, leaving the body of the organ intact. More partial operations than this—such as scraping—are also employed, but they can only be recommended in exceptional circumstances.

Epididymectomy.—The operator grasps the testis, turns it inwards so that the epididymis faces him, and makes an incision over it extending from the external abdominal ring—or higher up if the cord is definitely thickened—down to the lower limit of the testis. If an unopened abscess or a sinus is present, the incision must enclose the affected area, so as to remove it with the epididymis.

The tissues are divided until the cord, testicle, and epididymis are fully exposed, and the next step is to separate the two latter structures from one another. The separation is commenced at the body and globus minor, which is attached to the testis merely by fibrous tissue. Care must be taken in raising the epididymis to preserve the blood-supply to the testis, and this enters it chiefly on the inner side of the globus major, *i.e.* on the side away from the operator. The body of the epididymis is raised until the globus major is reached, and here there is close organic connection between the epididymis and the body of the testis.

The vessels are now carefully separated by a blunt dissector from the deeper surface of the globus major, and an examination must be made to see whether the body of the testis is healthy; if it is, the attachment of the globus major to it is divided. If the disease extends into the testicle, wedge-shaped portions of the testicular structure should be excised until all the disease has been removed. The epididymis and the vas deferens are now freed from the other structures of the cord, and the vas is isolated and divided as far up as the internal ring, or still higher if the cord is thickened there.

Bleeding points are tied and the incision in the testis is closed by a few fine catgut sutures through the tunica albuginea; the tunica vaginalis need not be closed. A drainage tube should be inserted at the lower part of the wound for the first forty-eight hours if there is much oozing. The majority of these cases heal without trouble; occasionally in advanced cases a fistula forms, and this may have to be scraped and treated on ordinary lines. In some cases the sexual functions improve.

Castration.—This operation is similar to that described for malignant disease (see p. 307). The cord should be divided as high up as possible, and it is well to slit up the external oblique aponeurosis and isolate the vas well up in the abdominal cavity before dividing it.

Scraping.—A partial operation of this kind should be limited to cases in which the disease has reached a very advanced stage, or has become generalised, and in which no other operation is thought advisable. It cannot remove all the disease, but it may do good by removing the breaking-down deposit that is giving rise to the abscess or the sinus.

Selection of cases.—Until fairly recently, the only question as regards treatment was between non-operative measures and castration, and the view generally held was that castration might be performed quite early in the acute form of the disease, but that in the ordinary chronic cases it should only be done as a last resort. At the present time, however, many of the objections to castration are removed by the operation of epididymectomy, and the patient will probably allow this operation to be performed at a much earlier stage than if castration were proposed, and the surgeon should advise it early rather than persist with non-operative measures, seeing that success depends upon the stage at which it is done.

Castration is the more effectual operation, when combined with section of the vas high up, and, were it not for certain objections, would be advocated in preference to any other. The objections are chiefly that it is impossible to be sure that the removal of the affected organ will arrest the disease, for, even at an early period, the tuberculosis may have affected the cord and the vesicula seminalis on the same side, and sooner or later the opposite epididymis becomes attacked in most cases. The proportion of cases in which both sides are affected is large. If, therefore, a patient cannot be offered a reasonable hope that the

other side will not become affected it may not be easy to persuade him to have castration performed at a sufficiently early period to give a fair prospect of complete recovery, while he may, nevertheless, consent to epididymectomy.

In some cases, however, castration is advisable in spite of the objections urged above. It is, for example, the only possible way of checking the disease in acute tuberculosis of the body of the testis, and must then be done as early as possible. It must also be done when there is great pain, especially when the body of the testis is extensively affected. It is also called for in advanced cases in which there is profuse suppuration which is telling upon the patient's health, and it may be required in these cases even though there be disease in the vesiculæ seminales and prostate.

These remarks apply to unilateral castration; bilateral castration is a very serious matter. In young patients little effect may be produced by removing both testes, but patients who are getting on in years frequently lose interest in their affairs, become less acute business men, and are lazy, irritable, morose, and in some cases actually become demented or maniacal after double castration. A considerable proportion of these patients ultimately commit suicide. The mental disturbance is attributed by some entirely to the psychical effect of the loss of the testis and the fear of subsequent sterility, and surgeons have tried to deceive patients by introducing artificial substitutes, such as balls of celluloid or silk. Quite apart from the fact that healing does not always occur over these materials and that they may ultimately require removal, these attempts have not met with much success, and practically have been given up.

It is generally admitted that the testes, in addition to their generative function, play a very important part in the well-being of the patient—probably, by means of their internal secretion—and it is to the loss of this that the mental effects of double castration are mainly due. There is ample evidence to show that, when the vasa are blocked by inflammation, or divided by operation, and the generative functions are thus abolished, the testes do not waste, nor are the mental effects described above noticed. Further, experiments on dogs seem to show that after the removal of both testes the animal is more susceptible to the tubercle bacillus. Dogs previously injected with testicular fluid resist inoculation with tubercle bacilli, whilst others, not so prepared, succumb.

Epididymectomy meets to some extent the objections to the operation of castration. The testis is left, and its internal secretion is therefore not interfered with, so that there is no objection to operation at the earliest possible period, and a similar operation will more readily be assented to should the disease reappear on the opposite side. Moreover, there is no need to urge palliative measures in opposition to operative means, such as epididymectomy, because the generative function of the affected testis is destroyed quite early in the disease by the blocking of the vas,

and therefore the removal of the epididymis and vas in no way affects the patient's generative power, while the early performance of the operation gives him a much greater chance of recovery.

The chief objection urged against this operation is that it is often only partial, because the disease may be present in the body of the testis itself; this no doubt is true in a good many cases unless the operation is performed at quite an early stage. There is, however, no reason why the operation should not be successful even then, provided that the tubercles left behind are fairly isolated and not in large masses. Moreover, the operation cuts off the communication between the testis and the rest of the genito-urinary system, and any recurrence that takes place in the testis can be treated locally by scraping out sinuses, etc. It is also urged that the testis may be found seriously diseased, and that castration may be necessary after all. This may certainly be the case, but the surgeon is then, at any rate, sure that he has not needlessly sacrificed an important organ. Epididymectomy is especially important in the case of the testicle first affected, because the disease is often more acute in the second testicle and may then necessitate castration.

Among the most serious objections to this operation is the risk of interference with the blood-supply to the testis and consequent necrosis of that organ. This has certainly happened, and great care must be taken not to carry out the operation when the disease is so extensive that it is necessary to interfere with the blood-supply, and also to preserve the vascular supply intact when the case is suitable for epididymectomy.

It is evident that the operation is well worthy of consideration, but it must be employed with judgment and is not applicable to every case. It is distinctly contra-indicated when the entire body of the testis is diseased, when there is a deposit in the centre of the testicle, when there are advanced lesions of the vesiculæ and prostate—especially with supuration—when the urinary system is invaded, and when the patient suffers from advanced phthisis. In the last two cases castration or scraping should be employed if operation is necessary, but, as a rule, expectant treatment will be most suitable.

CHAPTER XXX.

SYPHILITIC AFFECTIONS OF THE TESTIS: TUMOURS OF THE TESTIS: HERNIA TESTIS.

SYPHILIS.

THE testis may be attacked either in the congenital or the acquired form of the disease; in the latter case the affection usually occurs in the transition period between the secondary and the tertiary stages or late in the latter stage. In the congenital form and in the early tertiary stages the disease generally takes the form of an infiltration of the testis leading to a comparatively painless general enlargement of the body with loss of testicular sensation and, unless it is treated early and efficiently, loss of function results. This condition is usually associated with hydrocele, and when there is a hydrocele present in conjunction with enlargement of the body of the testis it is strong presumptive evidence that the affection is syphilitic.

Gummata are also met with in the later stages of syphilis, either deep in the substance of the organ or upon the tunica albuginea or in both situations, and these give rise to a hard nodular testis which may also be accompanied by hydrocele although not so frequently as the other form. Gummata may also occur in the epididymis, although much more rarely than in the body of the testis, indeed, gummata may even be met with in the epididymis alone, when they usually occur in the globus major; gummata have also been met with on the vas above the epididymis, but these conditions are rare.

A gumma of the testis if left untreated softens and breaks down, becoming adherent to the skin, which is thinned and gives way, so that a large gummatus ulcer with a sloughy base is formed. As the gumma in most cases finds its way through the tunica albuginea this ulceration is frequently followed by a hernia testis (see p. 305).

TREATMENT.—The treatment of syphilitic testicle is that for syphilis in general (see Vol. I. Chap. XI.). Little local treatment is

called for; the testis should be supported, and the scrotum may be smeared with unguentum hydrarg. or 5 per cent. oleate of mercury. When the gummata are large and extensive they often do not clear up entirely even under prolonged anti-syphilitic treatment.

HERNIA TESTIS.

By a hernia testis is meant a protrusion of the substance of the organ through an opening in the scrotum after perforation of the tunica albuginea. The term is sometimes applied to a protrusion of the entire testis through an opening in the scrotum, but it ought strictly to be limited to cases in which the tunica albuginea has given way and allowed the tubular structure of the body of the testis to protrude, and should not be applied to the cases in which the scrotum has sloughed sufficiently to allow the entire testis to be herniated. Hernia testis should not be confounded with the so-called fungus hæmatodes, which is a fungating malignant testicular growth.

A hernia testis may arise from the destruction of the tunica albuginea and the scrotal walls, as a result of the softening of a gumma of the testicle, or from the spread of a gummatous ulcer of the scrotum, which extends in depth until the testicle becomes adherent to its base, and finally the tunica albuginea becomes destroyed and the tubular structure protrudes. More rarely hernia testis may occur in extensive tuberculous disease of the body of the organ.

The herniated mass consists of seminal tubules with a large quantity of granulation tissue. It forms a vascular mass, varying in size from a large pea to a plover's egg, which projects from the scrotum and is somewhat constricted at its base, where the aperture in the skin embraces it. It is covered with granulations, and discharges a thin sanious fluid; occasionally it is in a sloughing condition.

TREATMENT.—*In syphilitic cases* the treatment is that appropriate for syphilis (see Vol. I. Chap XI.). In addition, it is well to dust the surface thickly with one part of calomel to three of starch, or equal parts of calomel, oxide of zinc, and starch. This treatment will sometimes bring about cicatrization of the hernia, and nothing further is needed. In other cases the projection only becomes reduced in size, and in them the remaining mass may be returned into the scrotum when the septic condition has been got rid of. If this is to be done, the best plan is to sponge the surface of the hernia with undiluted carbolic acid, two or three days before the operation, and to disinfect the skin around with 1 in 20 carbolic solution, and then apply compresses of 1 in 2000 corrosive sublimate, for twenty-four hours, over the hernia. The patient is anæsthetised and an elliptical incision is made to embrace the cicatricial opening, which is dissected out right down to the herniated mass, after

which the testicle is freed from the dartos, and it and the hernia are reduced, and the incision in the scrotum is sewn up. A small drainage tube should be put into the lower part of the wound for forty-eight hours in case the mass has not been rendered aseptic. Anti-syphilitic treatment should be continued. If the hernia is so large that it cannot be reduced in this manner, the surface should be shaved off and, after the bleeding has stopped, dusted with the calomel and starch powder.

NEW GROWTHS.

Tumours of the testis are rare, and are generally either carcinomata—which originate in connection with the tubuli seminiferi—or sarcomata of the round-celled or, more rarely, the spindle-celled variety. Sarcoma of the testicle is apt to undergo cystic degeneration, and the term 'cysto-sarcoma' has been applied to some of these tumours.

Malignant tumours of the testicle are very virulent. Sarcomata occur principally in young children, whilst carcinomata are most often met with between thirty and fifty years of age. As a rule the tumours, with the exception of the spindle-celled sarcomata, grow rapidly. At first they distend the tunica albuginea, and the form of the testis is retained; but this is soon destroyed, and irregular bosses of unequal consistence, and often fluctuating in parts, are formed. The disease spreads up along the cord, which becomes thickened, usually at a later stage than in inflammatory affections, and the lumbar glands are early affected both by carcinoma and sarcoma. The chances of cure by operation are slight.

In the early stages the diagnosis from a syphilitic testicle may be difficult, but the rapid growth of the tumour, its irregular outline and general characters, and the absence of marked hydrocele, soon settle the question. The tunica vaginalis becomes adherent to the testis, and the tissues outside it are then invaded. In untreated cases, death usually occurs within a year of the time when the tumour was first noticed.

Simple tumours of the testis are comparatively rare. The testis is one of the situations in which deposits of cartilage occur independently of bone-formation, and in some cases it is possible that these nodules of cartilage are true *non-malignant chondromata*, but in many cases they appear to be sarcomatous in nature, although, perhaps, not so malignant as the other forms of sarcoma. They grow somewhat slowly and are hard and nodular.

In *fibro-cystic disease* of the testis there is considerable enlargement of the organ. The tumour is usually noticed for the first time in early adult life, it is smooth or slightly nodular, painless, and not tender, and varies in its rate of growth within fairly wide limits. When the organ is removed, it is found to consist of a number of small cysts scattered in

a fibrous stroma, the testis proper and the epididymis being stretched out and flattened over one side of it. The exact pathology of these tumours is a matter of controversy. Some pathologists classify them as endotheliomata; others include them in a special class of blastomata, assuming that they are derived from undifferentiated embryonic cells. *Dermoid cysts* are extremely rare in the testis; they correspond to the dermoids of the ovary and, like them, are probably teratomata.

TREATMENT.—There is only one treatment for all these tumours of the testis—namely, castration. As a rule, the earlier the operation is performed the better will be the patient's chance, but unfortunately the diagnosis is often extremely difficult in the early stages when alone there is reasonable prospect of cure by radical measures. Malignant tumours of the testis occur at periods of life when syphilitic affections are also most common, and when the enlargement is still slight it is very difficult to exclude syphilis with certainty.

Under these circumstances the presence or absence of the Wassermann reaction should be ascertained, and if the result is positive it is legitimate to try the effect of salvarsan, or of large doses of iodide of potassium, combined with mercury and mercurial inunctions, for a week or ten days; if no improvement follows, further time should not be lost. The only way of setting the matter at rest is to cut into the testicle, and have a rapid section made; to the naked eye the soft, malignant tumour substance contrasts sharply with the dense, fibrous, syphilitic induration or the caseating gummata. The danger of infection of the surrounding parts, when cutting into malignant tumours, must always be borne in mind, and therefore the exploratory incision should not be made until the surgeon is prepared to complete the operation by castration, if necessary. If the tumour turns out to be malignant, the incision in the skin should be stitched up tightly so as to prevent the escape of any of the cells, and, after fresh disinfection of the skin, the area in which the incision has been made must be completely excised with fresh instruments.

Castration.—Removal of the testis may be performed either from below upwards—when it commences with enucleation of the testis—or from above downwards, when the cord is freed first. In most cases it is best to commence from above downwards, and in the case of malignant tumours—especially when there is an ulcer of the scrotum or when an exploratory incision has been made into it—the whole of the scrotum can be covered up with aseptic cloths while the cord is dealt with first. The same may be said of castration for tuberculous disease with or without ulceration; by dealing with the cord first, infection of the upper part of the wound by sepsis, malignant disease, or tuberculosis is avoided.

An incision about three inches long is made so as to expose the inguinal canal and the external ring on the affected side, the cord is identified as

it emerges from the ring, and the inter-columnar fascia and the aponeurosis of the external oblique are slit up as far as the internal ring. The cord is now followed up to the latter situation, and, if the vas is normal, an aneurysm-needle threaded with catgut is made to transfix the cord, which is tied in two halves, one end of the ligature being finally passed around the whole to prevent any chance of it slipping. The ligature should be tied as tightly as possible, so as to strangulate the nerves completely and avoid pain afterwards, and before dividing the cord it is well to clamp the lower end with a pair of forceps so as to prevent the escape of anything from the divided vas. Should the operation be done for tuberculous disease and the vas be found thickened at the proposed point of division, this structure should be separated from the other constituents of the cord and traced back as far into the abdomen as possible, the peritoneum being pushed aside in doing so, until an apparently healthy spot is reached, when it should be ligatured and divided. In this way the vas may be traced down a considerable way towards the bladder. The divided cord is now pulled well down out of the inguinal canal and the latter is sutured closely throughout its whole length; in cases of tumour, however, in which it may be advisable to attempt removal of the lumbar glands, the wound may be covered up until the testicle has been removed. Within the last few years an attempt has been made to bring the operation for malignant disease of the testis into line with those performed for malignant disease elsewhere, and the so-called 'radical operation' has been introduced. This consists in the removal of the organ, together with the glands and fascia of the posterior abdominal wall up to the level of the renal vein.

In order to remove the glands, the inguinal incision is carried outwards, to a point about half an inch above the anterior superior iliac spine, whence it curves upwards to the costal margin, which it reaches at the tip of the tenth rib. This is done after the cord has been isolated, as mentioned above, and then the incision is deepened, dividing the muscles of the anterior abdominal wall and transversalis fascia, until the peritoneum is reached. The peritoneum is now turned aside until the large vessels are exposed and then the vas is traced down well into the pelvis and divided. Next, the fascia and glands surrounding the spermatic vessels are dissected out, special care being taken on the inner side of the wound where the aorta and vena cava are exposed. This dissection is carried on until the renal vessels are reached, when the tissues which have been lifted up are cut across.

The cord, the tumour, the testis, and an elliptical portion of the scrotum are now removed together. Removal of the skin is imperative if the tumour is adherent to it, but in any case it is well to take away enough to prevent any cavity being left. Two semi-elliptical incisions should be carried from the lower end of the incision in the groin to the bottom of the scrotum and made to enclose a sufficient amount of skin. In cases of

tumour of the testis, the tunica vaginalis should always be removed as well as the testicle. After the skin and dartos have been divided, traction on the organ by means of the cord will usually enable the entire mass to be detached after a few touches with the knife.

After removal of the testis, every bleeding point should be tied. Oozing into the scrotum gives rise to much trouble on account of the laxity of the tissues and the long time it takes for the clot to become absorbed; moreover, the wound is near sources of infection. When the wound is sewn up, special care must be taken to see that the edges do not become inverted, as they often tend to do. The wound should be put on the stretch, with a blunt hook at each end of the incision, and either a running or a button-hole suture will close the cavity. It is well to insert a drainage tube for two or three days.

Castration should be employed in most cases of malignant disease of the testicle, even though the operation may not be curative—unless definite secondary tumours are present—as it saves the patient the great trouble and discomfort that the ulceration and sloughing of the growth must inevitably cause.

Of the value of removal of the lumbar glands it is impossible to speak definitely as it has only been performed a few times. It is a severe and difficult procedure, and it must be seen whether it yields a percentage of recoveries commensurate with its severity; so far, apparently, it has not prevented recurrence. Recurrence in the glands in this region does not necessarily take place after castration in early cases even though this elaborate operation has not been performed.

It seems reasonable that all cases in which it is suggested that this operation should be performed should be examined carefully by X-rays, in order to ascertain as far as possible whether the lungs are free from metastases or not. It would not be worth while performing an operation of this magnitude when there are deposits in the lungs.

CHAPTER XXXI.

HYDROCELE : HÆMATOCELE : VARICOCELE.

HYDROCELE.

ACUTE HYDROCELE.

THIS form is rare as compared with chronic hydrocele, and generally follows injury, or is secondary to acute epididymitis or orchitis ; sometimes it occurs in connection with an inflammatory condition of the scrotum or cord, and it may accompany thrombosis of a varicocele or follow specific fevers.

The surface of the tunica vaginalis becomes coated with lymph, which may ultimately cause some obliteration of the vaginal sac from adhesion of the opposed surfaces. The effused fluid coagulates readily, and as a rule is absorbed quickly when the primary cause ceases to act ; the condition may, however, become chronic. The outlines of the testicle and epididymis are lost and a smooth, fluctuating, translucent swelling is formed which is very tender, the skin over it being red and cedematous ; there is no pyrexia.

TREATMENT.—As this condition is a secondary one, the important point is the treatment of the primary trouble ; when this disappears the inflammation soon passes off. The treatment should be that appropriate for acute epididymitis (see p. 293). Operative interference is seldom required, but, if the pain is great and the swelling does not subside, it may be advisable to puncture the sac and draw off the fluid. There is, however, danger of introducing septic material into the sac, and, moreover, coagulation occurs if blood corpuscles become mixed with the hydrocele fluid, and the sac may become filled with clot, which will delay recovery and give rise to partial or complete obliteration of the cavity of the tunica vaginalis. In these cases a small exploring-needle should be used, and any visible vessels should be avoided. The patient should not be allowed to walk about until the fluid

has become completely absorbed, lest a chronic hydrocele should result.

Suppuration may sometimes occur in acute hydrocele, and is recognised by an increase in the pain and the local symptoms, accompanied by pyrexia; the tunica vaginalis must be laid open freely as soon as the condition is recognised. The skin is disinfected in the usual manner, a vertical incision is made over the outer and front part of the swelling or over any situation in which the abscess is pointing, and the pus is let out; a drainage tube is inserted at the most dependent point, and antiseptic dressings are applied, the scrotum being supported as for acute epididymitis (see Fig. 71). Healing is generally complete in about a fortnight.

CHRONIC HYDROCELE.

The following forms of hydrocele are described, according to the situation of the fluid: *hydrocele of the tunica vaginalis*—the commonest variety; *congenital hydrocele*—in which the funicular process is patent from the abdominal cavity to the bottom of the scrotum; *infantile hydrocele*—in which the lower part of the funicular process is unobliterated and communicates with the tunica vaginalis; and *hydrocele of the cord*—in which the funicular process is obliterated at the internal ring above and in the neighbourhood of the epididymis below, but open in the middle of its course. There may also be a *spermatocele* or *encysted hydrocele of the epididymis*; *encysted hydrocele of the testis* itself—which is generally a collection of fluid beneath the visceral layer of the tunica vaginalis; and *chylous or fatty hydrocele*—in which there is a communication with the lymphatic vessels. Occasionally, *diffuse hydrocele of the cord* is met with; in this form, the fluid is more or less evenly distributed through the structures of the cord.

HYDROCELE OF THE TUNICA VAGINALIS.—The tunica vaginalis is distended with a clear, highly albuminous fluid, coagulating readily on the addition of red blood corpuscles. It is common in infants; in adults it is probably associated with some inflammatory affection of the epididymis. It is not uncommon as a complication of gummatous disease of the testis, and is met with in connection with long-standing herniæ.

The tunica vaginalis may remain normal in appearance and in thickness for a long time, but eventually—especially when attacks of acute inflammation supervene—it may become thickened and the hydrocele may develop into a hæmatocele. Adhesions may form between the opposed surfaces of the tunica vaginalis and divide the hydrocele cavity into a number of compartments.

The diagnosis of hydrocele is easy, but it must be borne in mind that the affection is not infrequently complicated with a hernia, and it

is also not uncommon to find disease of the body of the testis or epididymis when the hydrocele fluid is drawn off.

Treatment.—In children, active treatment is rarely called for. *Lotio plumbi* may be applied, and the fluid will usually become completely absorbed in the course of a few months. In adults it is advisable to get rid of the hydrocele, as, although when small it does not trouble the patient materially, it becomes steadily larger if left alone, until it may be a source of great discomfort from its size and weight.

When the hydrocele is due to gummatous disease of the testis, the cure of that affection will generally lead to the disappearance of the hydrocele. This also holds good when the diagnosis has not been made until the hydrocele has been tapped; no further treatment of the hydrocele need be carried out until the effect of anti-syphilitic treatment is apparent.

Many methods have been introduced for the treatment of hydrocele, of which we may mention the following: Simple tapping, tapping followed by the injection of irritants into the sac, irrigation of the cavity with irritants, incision and drainage, stuffing the cavity, and excision or eversion of the tunica vaginalis. Of these, the only ones that require any detailed description are tapping followed by injection, and excision or eversion of the hydrocele sac.

Simple tapping (see p. 313) does not lead to a cure. It may be employed when the patient objects to more radical treatment, or when he cannot afford to lie up for so long a period as a week or ten days. Simple tapping without injection is not curative, and only relieves the patient of his discomfort for a time. The objections to repeated tapping, apart from its inefficiency as a curative method, are the risks of sepsis—which, however, should not be great—and the risk of bleeding into the sac, leading to the formation of a hæmatocele. The points to be borne in mind in tapping a hydrocele are that the disinfection of the instruments and the skin should be perfect, and that any visible vessel should be avoided.

Drainage was at one time much employed, but it necessitates the patient lying up for from ten to fourteen days and possesses no advantage over the more radical methods. The same remark applies to opening and stuffing the hydrocele with gauze, which is a very objectionable method on account of the danger of sepsis and the slow recovery. It is not even justified by the desire to obtain a radical cure, as this can be more certainly obtained by other methods.

Tapping, followed by injection, no doubt often leads to a cure, and is in some ways a less severe procedure than excision. There is no necessity for a general anæsthetic, and possibly the patient is able to get about sooner. At the same time it is inferior to excision or eversion, as it is uncertain in its results and is accompanied by a certain amount of risk, especially in old subjects who are in bad health, for the injection may

set up more inflammation than is desirable, and, indeed, has even led to sloughing of the scrotum.

The fluid formerly used for injecting hydroceles was the Edinburgh tincture of iodine, which is stronger than that of the British Pharmacopœia, and a dram or more of this was introduced into the sac and left there. This operation is accompanied by considerable pain at the time, and brisk inflammation afterwards, and for this the patient has to lie up. Recently, iodine has been largely abandoned in favour of undiluted carbolic acid, or carbolic acid and glycerine, which is the fluid that we should recommend when this method is chosen. It is probably more efficient than iodine, and its use is not accompanied by the pain that follows injection of the latter fluid.

The method is as follows : The skin at the proposed seat of puncture is shaved and disinfected, the patient sits well forward upon the edge of the chair, with the legs apart, and a medium-sized trochar and canula is thrust into the hydrocele. The point chosen for the puncture should be at the anterior part of the swelling, rather above the middle, and at a spot free from visible veins ; the skin should be made tense over the tumour by grasping it behind its median transverse plane between the left thumb and forefinger ; as the thumb and finger are approximated, the tumour slips forward, and the skin is pulled backwards and made tense. It is always advisable to make out the position of the testicle beforehand, both by palpation and the translucency test, as in some cases the ordinary position of the testis—namely, at the lower and posterior part of the swelling—is altered, and the organ is situated in front. The canula is held as shown in Fig. 73, the right forefinger being placed three-quarters of an inch from the point of the trochar so as to prevent it from going too deep, and it is introduced by a sharp stabbing thrust. Directly it has reached the interior of the cavity—as will be ascertained by the cessation of resistance—the point is tilted upwards, the trochar is withdrawn, and the open end of the canula is somewhat depressed and pushed a little farther onwards so as to avoid any risk of its slipping out of the tunica vaginalis. The fluid is drained off as completely as possible, the tunica vaginalis being compressed by the left hand.

When all the fluid has escaped, carbolic acid is introduced through the canula—preferably by a syringe which fits the nozzle of the former. Should the surgeon not happen to have a syringe of this kind at hand, the best plan is to take a hypodermic syringe with a long exploring needle pass the latter down the canula well into the tunica vaginalis, and then inject the fluid. In this way there is no risk of the carbolic acid coming in contact with the skin. The fluid for injection should be the ordinary B.P. liquid carbolic acid. For a small hydrocele ℥xx will suffice, while for a large one the amount may be ℥xl or ℥l. In no case should this quantity be exceeded. In feeble and old people the carbolic acid may be mixed with an equal quantity of glycerine.

After the acid has been introduced, the skin is pinched up around the canula, the finger placed over its open end, and the latter rapidly withdrawn; the walls of the tunica vaginalis are then rubbed together so as to smear the carbolic acid thoroughly over their surface. The small puncture in the skin is closed with salicylic wool and collodion.

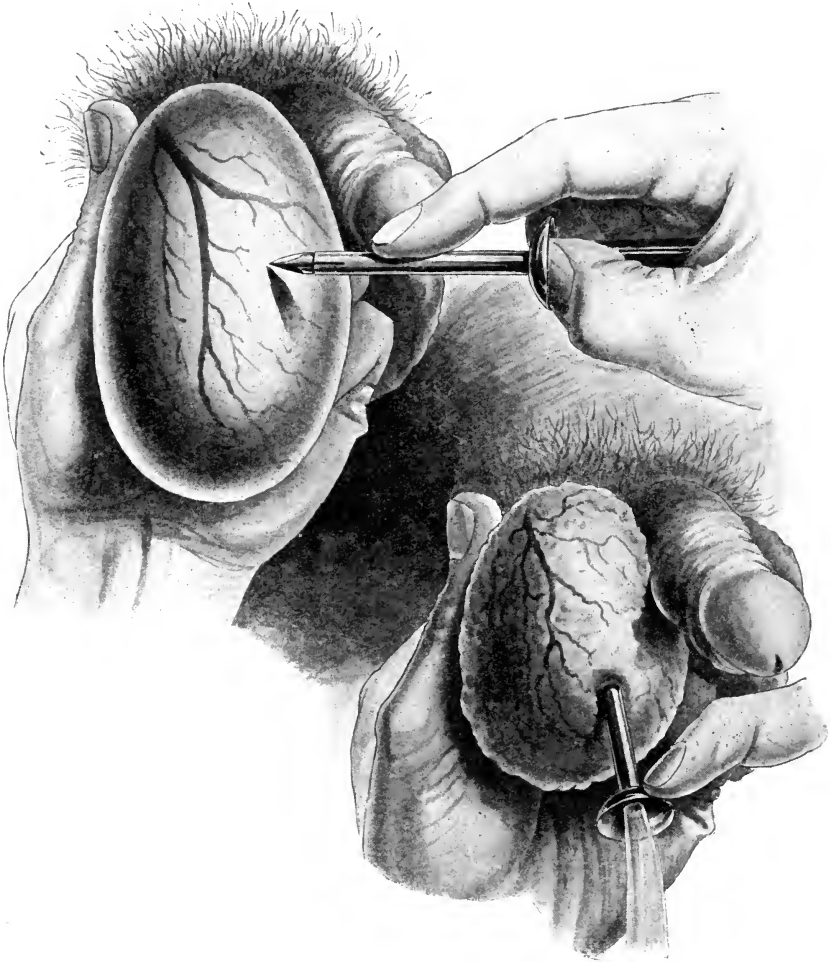


FIG. 73.—THE METHOD OF TAPPING A HYDROCELE. The upper figure shows how the trochar and canula are held, and how the hydrocele is made tense. The lower one shows how the canula is held when the fluid is escaping, and how the tunica vaginalis is compressed in order to empty it thoroughly.

The operation is not painful; the patient merely experiences a slight warmth at the time the fluid is introduced, and this is soon succeeded by a sensation of numbness. He should go to bed for twenty-four hours after the injection, and have the testis supported. The injection is usually

followed by some swelling, unaccompanied by pain or signs of inflammation. A certain amount of fluid is effused, but this soon becomes absorbed and the swelling disappears. If possible, the patient should be kept in bed until the swelling has almost gone, but recovery will proceed even if he goes about with the testicles supported by a suspensory bandage.

We are strongly of opinion that excision or eversion is the best treatment for any patient who desires a radical cure and can give up about a fortnight to the treatment, especially if he is advanced in years or feeble in health. They are simple operations which, if carried out aseptically, are not dangerous, and absolutely prevent recurrence. Moreover, they will succeed where injection would certainly fail—for example, when the sac is multilocular or contains loose bodies.

Excision of the wall of the sac.

—The strictest asepsis is necessary; the scrotum and pubes are shaved, and special care must be taken to see that the parts are thoroughly disinfected. The tumour is grasped slightly behind its centre, the skin is made tense over it, and a vertical incision is carried from the upper to the lower limits of the swelling and steadily deepened until the thin tunica vaginalis is evident. The cord and its coverings are now separated from the tunica vaginalis with a blunt dissector or the finger, care being taken not to puncture the hydrocele until the whole of the tumour can be turned out of the wound with the testicle and epididymis forming the base of the swelling.

When the hydrocele has thus been isolated, the tunica vaginalis is opened with scissors, the fluid allowed to escape, and the parietal portion of the tunica vaginalis clipped away as close to the testis and epididymis as possible. The portion of the tunica vaginalis covering the testis cannot be removed, but, in order to avoid any possibility



FIG. 74.—THE INCISION THROUGH THE WALL OF A HYDROCELE IN THE OPERATION FOR EVERSION OF THE SAC.

of secretion occurring from its surface afterwards, it is well to brush it over lightly with undiluted carbolic acid and then wash away any excess of the acid with sublimate solution.

Great care must be taken to stop all bleeding, because a considerable hæmatoma may form if oozing continues after the wound is closed, and this would delay healing; it is impossible to apply direct pressure to stop this oozing. The wound is closed with a fine continuous button-hole suture, the incision being put slightly on the stretch by blunt hooks introduced at the upper and lower angles, and care must be taken in doing this to see that the edges of the skin do not curl in. A drainage tube should

be introduced into the lower angle of the wound for twenty-four hours; this will not delay the progress of the case. Dressings similar to those for the radical cure of hernia (see Vol. IV. p. 490) are applied, and the sutures may be removed on the fifth day. The patient may be allowed to get up at the end of the first week, and the scrotum should be well supported by a suspensory bandage or by a mass of wool in the perineum, kept in position by a bandage in the form of a St. Andrew's cross.



FIG. 75.—EVERSION OF A HYDROCELE SAC. The figure shows the tunica vaginalis everted and the sutures inserted.

Eversion of the sac.—This method is a useful alternative to the above. It has the advantage over excision that it is easier to make sure of complete hæmostasis, and therefore there is less risk of a troublesome hæmatoma afterwards. The operation is commenced as before (see Fig. 74), but after the tunica vaginalis has been turned out of the scrotum, and has been incised, it is not clipped away, but turned back over the epididymis and cord, in two flaps, which are united with catgut sutures (see Fig. 75). The operation is completed as before.

CONGENITAL HYDROCELE.—Here the funicular process is open from the peritoneal cavity down to the bottom of the scrotum, and the hydrocele fluid is in direct communication with the peritoneal cavity. The aperture into the abdomen varies much in size; it may be large enough to allow the descent of a hernia or it may be a mere pin-hole. There is a distinct impulse on coughing if the communication is at all free, and in any case the fluid will return into the abdomen by gravity when the patient lies down; the rate at which this disappears may give some indication as to the size of the communication.

Treatment.—These hydroceles are generally noticed soon after birth,

and the question of treatment will arise quite early. It is obviously inadvisable to inject irritants lest they should find their way into the peritoneal cavity; on the other hand, it is not an uncommon experience to find that, after evacuating the fluid with a fine trochar and applying evaporating lotions, followed in a few days by a pad and bandage, the fluid does not re-accumulate, the walls of the sac become adherent, and the communication with the peritoneal cavity becomes obliterated. If necessary, the puncture may be repeated more than once, and is best done with the exploring-needle of an ordinary hypodermic syringe.

If this treatment is ineffectual, the surgeon should wait until the child is at least three months old, and then excise the sac. Excision is advisable for several reasons. In the first place, injection is out of the question because of the communication with the abdomen, and, in the second, the aperture of communication may enlarge and a congenital hernia may result, and this is greatly facilitated by the distension of the inguinal canal from the presence of the hydrocele.

Excision.—The incision is similar to that for the radical cure of hernia (see Vol. IV. p. 489); the cord is raised, the testicle drawn from the scrotum, and the hydrocele sac identified, clipped off on a level with the epididymis below, and stripped up from the other structures of the cord—like a hernial sac—as far as the internal abdominal ring. The rest of the operation is exactly similar to that for the radical cure of congenital hernia (see Vol. IV. p. 493).

INFANTILE HYDROCELE.—Here the funicular process is open from the internal abdominal ring down to the bottom of the scrotum, but there is no communication with the abdomen. There is often an imperfect impulse on coughing, as the upper end of the hydrocele extends into the inguinal canal, but this form of hydrocele differs from the congenital form in that the fluid does not return into the abdomen.

Treatment.—Injection is not advisable on account of the anatomical situation of the hydrocele. If the swelling is large and does not disappear after a few months, it may be punctured, and evaporating lotions applied; if this fails to cure it, the child should be left until he is a little older, when the sac should be excised. The treatment is practically the same as that for congenital hydrocele (*vide supra*).

ENCYSTED HYDROCELE OF THE CORD.—Here there is an ovoid swelling somewhere in the course of the cord, usually extending downwards from the external ring and due to effusion of fluid into an unobliterated portion of the funicular process of the peritoneum. The hydrocele varies in size from a small marble to a large brazil-nut, and in the former case is rounded, whilst in the latter it is elongated or ovoid. When the swelling extends up through the external abdominal ring it may be pushed down on coughing, but there is no expansile effect, and

the close connection of the cord with the tumour and the translucency of the latter will demonstrate the nature of the affection.

Treatment.—The hydrocele should be excised through an incision extending downwards from the external abdominal ring, so as to expose it thoroughly. The parts are made tense over the tumour, which is cut down upon, layer by layer, and the constituents of the cord are separated from the sac wall; the latter is then removed. The operation is very simple, and healing should take place in a few days. Should there be a hernia present as well, a radical cure (see Vol. IV. p. 489) should be done at the same time.

Occasionally, the hydrocele sac contains a milky fluid, and the condition is then termed *chylous or fatty hydrocele*. Here there is some communication between the lymphatics and the hydrocele sac, and the condition is most common in those who are the subject of filariasis. Excision is better in these cases than tapping and injection.

ENCYSTED HYDROCELE OF THE EPIDIDYMIS.—These are really cysts and not distensions of the tunica vaginalis or the funicular process. There are two forms of encysted hydrocele of the epididymis, one of which contains spermatozoa and is commonly called a *spermatocele*, and the other, in which there is clear fluid without any spermatozoa. The cysts are very slow in development and seldom attain a large size. They are usually globular, and may be multilocular, and if large enough will show translucency unless the fluid is opalescent.

Treatment.—The cyst causes no trouble apart from the inconvenience due to its size, and therefore no treatment need be undertaken if it is small. If, however, its presence causes the patient any annoyance, the best plan is to cut down upon it and excise it. Tapping, followed by injection, will also cure a good many of these cases.

HYDROCELE OF A HERNIAL SAC.—Occasionally, a hernial sac becomes obliterated at its neck, and the fundus becomes distended with serous fluid and gives rise to a fluctuating translucent tumour closely resembling an encysted hydrocele of the cord.

Treatment.—This should be the complete removal of the sac, followed by radical cure of the hernia (see Vol. IV. p. 489).

HÆMATOCELE.

In a hæmatocele the tunica vaginalis becomes filled with blood, and the affection may either follow an injury or may occur in connection with a hydrocele of the tunica vaginalis.

TRAUMATIC HÆMATOCELE.

This may follow severe contusions of the testis and scrotum, and a similar condition may occur when a vessel is punctured during tapping

of a hydrocele and bleeding goes on into the hydrocele sac. In these cases the tunica vaginalis becomes rapidly distended with blood, there is generally a good deal of pain, and the diagnosis is comparatively easy.

IDIOPATHIC HÆMATOCELE.

This condition is more common than the preceding one, and generally results from the giving way of delicate vessels in the thickened walls of an old hydrocele, so that hæmorrhage occurs into the cavity of the tunica vaginalis. The blood-clots on the surface of the tunica vaginalis become partially organised, and the sac wall therefore becomes increasingly thick—the visceral as well as the parietal layer being affected. After a time, calcareous salts are deposited in the imperfectly organised clots, so that ultimately a dense, calcareous cyst wall may be formed, which may exert injurious pressure on the testicle and lead to its atrophy. The swelling closely resembles a hydrocele in shape and situation, but differs from it in the density of its walls, in the difficulty of making out fluctuation, in its greater weight, and in the absence of translucency.

TREATMENT.—Of **acute traumatic hæmatocele.**—The patient should be put to bed, the testicle supported, and cold applied to the parts by means of an ice-bag or Leiter's tubes. Unless it be evident in the course of a few days that absorption of the clot is taking place, the best plan is to make a small incision, evacuate the clot, and drain the sac for a few days.

Of **chronic idiopathic hæmatocele.**—The only treatment of any avail is excision, and this may either take the form of excision of the parietal portion of the tunica vaginalis, or removal of the whole of the tunica vaginalis combined with castration. Tapping, followed by injection, is useless. Laying open and draining the sac seems to possess no advantages over excision—except, possibly, that there is less risk of injuring the structures of the cord, which are often intimately adherent to the sac wall—whilst the risks of sepsis are much greater than after excision, and the results are not so satisfactory because the wall of the hæmatocele will not collapse properly if it is very rigid. The difficulty of identifying the vas may be overcome by tracing it down from above.

In excising a hæmatocele the vas and cord must first be separated from the sac wall right down to the testis, after which the hæmatocele is isolated from its various coverings, its wall laid open, the clots turned out, and the parietal portion of the tunica vaginalis clipped away.

Castration may be necessitated by the presence of a very dense calcareous sac wall, which cannot be clipped away, and it may be done all the more unhesitatingly because the pressure exerted by the calcareous sac wall will probably have damaged the testis irretrievably. The operation is easy, as the cord can be divided an inch or so above the

swelling, and need not be followed up into the inguinal region. It is well, also, to excise an elliptical portion of the scrotum, so as not to leave a large pouch in the scrotum in which blood may accumulate.

VARICOCELE.

This is the name given to a varicose dilatation of the pampiniform plexus, which is a common affection about the age of puberty. It is probably predisposed to by the great length of, and slow circulation through, the spermatic vein, by the constriction exerted on the veins at the external abdominal ring, and by hereditary tendency. The fact that it is more common on the left side than on the right is supposed to be accounted for by the fact that the left spermatic vein lies behind the sigmoid flexure, and so has pressure exerted upon it when the loop of bowel is full of fæces, and also by the fact that the vein opens into the left renal vein at right angles instead of obliquely.

Some patients have large varicoceles without any symptoms, whilst others suffer much from a slight degree of the affection, and it is probable that the neurotic element enters largely into these cases. The complaint made is generally of aching pain in the back and groin, especially in the region of the genito-crural nerve, and the patient is often alarmed lest the generative function of the testis should be impaired. Real atrophy of the testis rarely occurs, however, as the result of a varicocele.

Some discussion has arisen as to the effects of operation on the testicle, and there seems to be no doubt that in a considerable number of cases the testicle becomes somewhat indurated from the development of fibrous tissue in it, and grave doubt has been expressed as to the advisability of performing the operation as frequently as was done up till recently. The chief reason for performing the operation has been to allow the patient to obtain admission to various public services—especially those involving residence in hot climates—partly because the varicocele is apt to become very large and painful in a hot climate, and partly because a man who wishes to shirk his work can always say that he suffers pain from the varicocele. Lately, the objections to the operation have been recognised, and it is only now insisted on—as regards the public services—in really bad cases. Apart from the question of admission to the services, the operation should only be done in patients who are not markedly neurotic and who have large varicoceles which are causing pain or discomfort. In highly neurotic patients—especially in those whose mind is concentrated on their genital organs and who are very often masturbators—the operation should not be done, as the mental relief is not so great as might be expected, and they often come complaining subsequently of neuralgia in the testicle and cord, and their last condition may be worse than their first.

TREATMENT.—Palliative.—When the patient does not suffer great inconvenience, or when he has no wish to enter one of the public services or to live in a tropical climate, only palliative measures are necessary in most cases; these chiefly consist in supporting the testis with a well-fitting suspensory bandage, regulating the bowels in order to prevent accumulation in the sigmoid flexure, and bracing up the parts by the employment of cold douches every morning. The patient should be reassured as to the improbability of damage occurring to the generative function of the testis.

Operative.—When an operation is desired, a complete cure as far as the veins are concerned can be effected by a simple operation, which is unaccompanied by risk if it is done aseptically.

The operation we prefer is done as follows: The parts are shaved and disinfected, and an incision about an inch long is made over the cord immediately below the external abdominal ring, the veins and the other structures of the cord being rendered prominent by grasping and making the skin tense over them. As soon as the fascia covering the cord is reached, the finger is introduced, and the whole of the cord can be pulled out of the small wound and exposed with very little trouble. The cord is then cleared from the external ring right down to the testis with a few touches of a blunt dissector, and the next point is to isolate the vas from the other structures of the cord. The spermatic artery and nerve go with the vas, and it is usually well to leave one or two small veins in connection with this structure. The whole of the remaining mass of veins is then isolated: first, above where the veins converge and join up into a few large trunks and where therefore the separation is easiest, and then downwards as far as may be desired. The whole of this mass is then ligatured in two places, and the intervening portion is excised. The distance at which the ligatures are placed apart—*i.e.* the length of the portion of veins excised—will be determined by the degree to which the testicle is pendulous; in most cases about an inch is quite sufficient. The simplest way of determining the amount is to tie the lower ligature first, just above the epididymis, and then, holding the upper part of the cord firmly in position, to make traction upon this ligature so as to pull up the testis and see how much shortening is required. In removing the mass of veins a good quarter of an inch should be left beyond the ligature in order that the latter may not slip off. The ends of the ligatures are left long, and tied together, so as to bring the two divided ends of the cord into apposition, and then cut short. By this plan the chief veins are removed, and the testis is braced up and secured in position. Finally, all bleeding points are tied, the wound is sutured, and healing is complete in a few days; afterwards, the patient should wear a suspensory bandage for a few weeks, when he may be considered permanently cured.

SECTION II.—AFFECTIONS OF THE URETHRA AND PROSTATE.

CHAPTER XXXII.

CONGENITAL MALFORMATIONS OF THE URETHRA.

THESE conditions are rare; the most important are hypospadias, epispadias, and complete or partial occlusion of the urethra. Abnormal communications between the urethra and the rectum are described in Vol. IV. Chap. XXXIV.

CONGENITAL STRICTURES.

Congenital strictures of the urethra are met with in various situations; for example, the stricture may be situated at the external meatus, in the

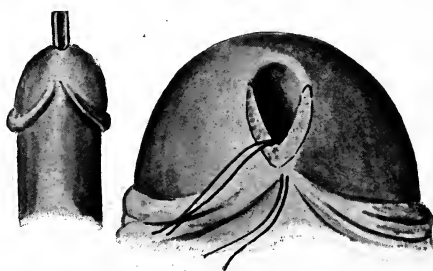


FIG. 76.—THE METHOD OF ENLARGING AN UNDULY SMALL MEATUS. In the left-hand figure, the director is shown introduced into the meatus. In the right-hand one, the meatus has been slit up and the sutures inserted.

penile portion just behind the ossa navicularis, or close to the prostatic urethra, and it usually takes the form of a valvular fold or diaphragm. In the adult, the meatus will normally admit a No. 12 English bougie, and in children of two or three years it should admit a No. 4 or 5; if this is not the case, the meatus must be considered unduly narrow. Narrowing of the external meatus is not uncommon in conjunction with

phimosis; in all cases in which circumcision is performed, the meatus if too small, should be enlarged. The irritability of the bladder, for which circumcision is often performed, may be really due to this cause and when the symptoms are not relieved by circumcision, the reason

often is that the narrowing of the urethral orifice has not been recognised and attended to. An unduly small meatus may lead to injurious backward pressure; moreover, the patient will suffer severely should he contract any form of urethritis.

TREATMENT.—*Of constriction of the meatus.*—A director should be passed into the meatus, with the groove towards the ventral aspect of the penis, and the urethra is slit up for an eighth to a quarter of an inch. In order to prevent recurrence of the constriction as the wound heals, the divided mucous membrane of the urethra may be sutured to that of the glans (see Fig. 76). The stitches are usually removed at the end of three days. In some cases a free incision has to be made, and when the wound is too extensive to be treated by stitching the mucous to the cutaneous surfaces, a small triangular flap may be raised from the frenum and interposed between the cut lips of the meatus. The apex of the flap should be situated at the point of attachment of the frenum to the penis, and is fastened to the distal end of the urethral mucous membrane with fine catgut; the flap should be raised before the meatus is slit.

Of congenital strictures above the meatus.—These are usually simple diaphragms, which can be divided through a urethroscope (see p. 362). Dilatation should be maintained as in cases of acquired stricture (see p. 383).

HYPOSPADIAS.

This condition is the result of incomplete fusion of the lips of the uro-genital sinus which forms the urethra, and varies in degree from an unduly large meatus to a completely cleft urethra. This deformity, unlike the somewhat similar condition of epispadias, never extends into the bladder, and incontinence of urine is therefore not one of its complications.

In hypospadias affecting the glans penis the inconvenience to the patient may be so slight as to be almost unnoticeable, but it increases the farther back the cleft extends. There are two troubles in connection with hypospadias. In the first place the urethral opening is often unduly narrow and there is consequently some back pressure, from which serious results may follow. Hence in operating on these cases it is always essential to see that the orifice is made of full size. The second important point is that the penis is always curved downwards when the cleft in the urethra extends any distance backwards, and this incurvation is greater the further back the cleft extends. Attempts to straighten the organ are resisted by a fibrous band corresponding to the remains of the uro-genital groove and lying in the position of the normal urethral roof. This incurvation produces much inconvenience, as the urine is projected against the curved organ, the stream is broken up, and the scrotum

is constantly wetted ; in children this often gives rise to troublesome eczema, and in addition there is generally some dribbling into the clothes and consequent offensive ammoniacal decomposition. When the incurvation of the organ is not extreme, this trouble may be avoided by lifting up the glans when passing water, and holding it out of the way of the urinary stream, but in extreme cases this is not possible. When the urethral orifice is situated farther back than the glans, coitus is practically impossible, as proper erection is prevented by the incurvation. When the cleft extends still farther back and is associated with a cleft scrotum, the condition closely resembles hermaphroditism and the rudimentary organ is useless.

From the point of view of treatment the cases may be divided into three groups : those in which the fissure is limited to the glans ; those in which the cleft is in the penile portion, and the orifice of the urethra opens anteriorly to the scrotum ; and those in which the scrotum is cleft and the urine issues from an opening in the perineum.

TREATMENT.—Treatment is only of avail when the urethral orifice is in front of the scrotum. When the latter is cleft and the urine passes through a perineal opening the chances of repairing the urethra are very slight, and, moreover, operative interference is not called for so urgently because the trouble in micturition is not marked. Therefore it would seem advisable not to interfere in cases of *complete hypospadias*.

The sex of these cases is, however, sometimes a matter of doubt, and many cases of so-called hermaphroditism are really cases of cleft scrotum with a rudimentary penis. Careful examination will almost always reveal the true nature of the condition, but when any doubt exists, the child should be brought up as a male.

When the hypospadias simply consists of an *unduly large meatus* it is often unnecessary to interfere at all. The main point of importance is to make sure that there is no constriction at the orifice of the urethra ; should constriction be present, the orifice must be slit up in the manner described on p. 322.

When the condition is one either of complete hypospadias glandis or of that combined with a cleft of the urethra in front of the scrotum, it is advisable to make an attempt to repair the urethral canal, and the first question is as to the age at which this should be done. The best age would seem to be from six to twelve years of age, but it can be performed as early as three ; by that time the patient is amenable to discipline, there is plenty of time for the genital organs to develop after the operation, and, moreover, there is not so much likelihood of trouble occurring from erection of the organ as there is when adult life has been reached. Erections are apt to be fatal to the success of any operation.

Three points have to be attended to in treating a case of hypospadias. In the first place the curvature of the penis must be remedied ; in the second, the natural orifice of the urethra must be made of normal size ;

and in the third, a fresh urethra must be formed, extending from this orifice to the end of the glans. It is impossible, in any but the most trivial cases, to perform the whole operation at one time, and at least three operations will be necessary. Smaller operations may also be subsequently required to remedy failures in any particular situation. The treatment takes a long time, and it is well to allow a considerable interval to elapse between each stage; hence it is hardly safe to reckon on finishing with a case of hypospadias under a year at least.

In operating, several points must be borne in mind. In the first place the superficial tissues are lax, and hence it is possible to perform a plastic operation of a kind which would be impossible in dealing with more rigid tissues. A second point is that in these cases the prepuce is represented by a large hooded flap of tissue on the dorsum of the penis which is chiefly vascularised by one or more vessels which enter it near the middle line. A third point is that union is apt to be interfered with by the constant passage of urine over the wound, and hence it is necessary to provide for the adequate nutrition of the flaps by every possible means.



FIG. 77.—URETHROPLASTY FOR HYPOSPADIAS. Formation of a button-hole in the preputial hood. The hole has been made and the sutures are being inserted. (Edmunds.)

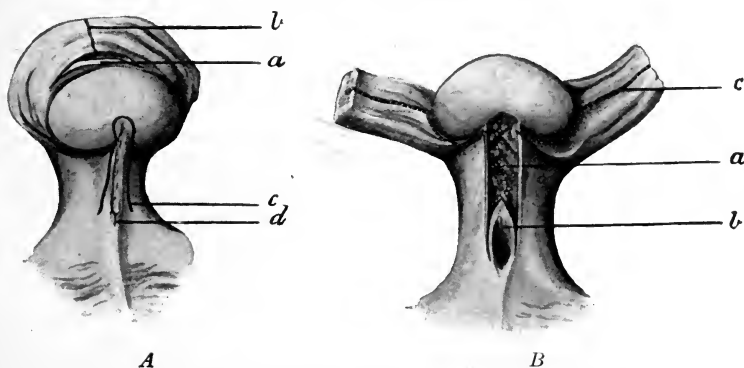


FIG. 78.—URETHROPLASTY FOR HYPOSPADIAS. A, Straightening the penis. The remains of the corpus spongiosum are dissected out by means of the incision, c, right down to the opening of the urethra, d. The prepuce is divided by the incision, b, from the button-hole, a.

B, The penis straightened. The end of the urethra, b, is now free, and lies at the lower end of the groove, a, the skin at the sides of which are undercut in the direction of the dotted lines. The dotted line, c, is the incision preliminary to forming the roof of the new urethra. (Edmunds.)

Urethroplasty.—A large number of operations have been described, but for the majority of cases the following method devised by Mr. A. Edmunds (*Lancet*, 1913, vol. i. p. 447) will be found satisfactory. The operation is performed in three stages.

First stage.—The first step consists in making an incision through

the whole thickness of the prepuce so as to form a sort of button-hole, the edges of which are then stitched (see Fig. 77) in much the same way as a tailor finishes off a button-hole in a coat; this incision is made about the centre of the prepuce and close to its reflection from the penis. The object is to divide the dorsal vessels of the prepuce and lead to the formation of a number of smaller vessels which will vascularise the prepuce from the sides. The wound thus made is allowed to heal and the resulting cicatrix to soften before the second stage is commenced; about three months should be allowed to elapse between these two stages.

Second stage.—An incision is made from the middle of the button-hole to the free border of the prepuce (see Fig. 78, *A*) dividing the whole thick-

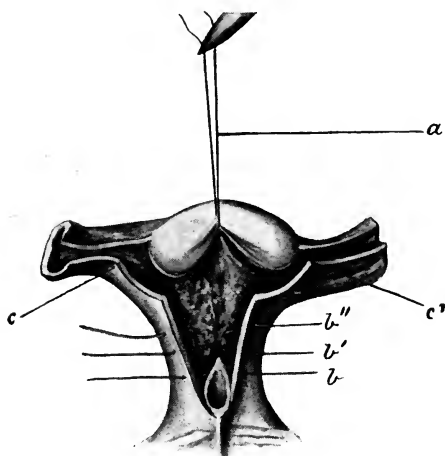


FIG. 79.—URETHROPLASTY FOR HYPOSPADIAS. *Formation of the roof of the new urethra.* This figure shows how the skin is undercut in order to get the edges together. The penis is held straight by means of the suture, *a*, and the sutures, *b''*, *b'*, *b*, are inserted through the skin edges and the raw surface on the ventral mesial aspect of the penis. The preputial flaps, *c*, *c'*, have been split. (Edmunds.)

ness of the prepuce and forming two irregular flaps (see Fig. 78, *B*). A second incision is then made along each side of the urethral groove, beginning behind on each side of the orifice of the urethra, and these are joined in front by another in the glans around the point where the meatus would normally be situated, the whole forming a long inverted U-shaped cut around the urethral groove (see Fig. 78). The opening of the urethra is often constricted or bounded by a thin fold of mucous membrane, and should also be divided by a short vertical incision. The incisions along the urethral groove are now deepened so as to dissect

up this structure completely; this is best done by a series of short cuts, made obliquely as shown in Fig. 78, *B*. When this has been carried out the penis will be straight, and there will be a broad raw surface on its under aspect, at the scrotal end of which is the detached urethral groove with the opening of the urethra at its lower part; this groove does not remain as an elongated flap, but contracts into a very small mass (see Fig. 79). An incision is now made on each side of the inner surface of the preputial flaps, starting from the anterior portion of the raw area and passing round the corona and about a millimetre distant from this structure, until the middle of the preputial flap is reached; the direction of the incision is then altered, and it is carried along the long axis of

the flap up to the free edge (see Fig. 78, *B*). This incision should extend just through the skin, and it will then be possible to pull apart the edges and open out the lax tissues so as to produce the condition shown in Fig. 79; this should be done with as little actual cutting of the tissues as possible.

The next proceeding consists in passing stitches so as to slide in skin from the preputial flaps and thus cover the whole of the raw area with skin, part of which will ultimately line the new urethra. It is well to begin by passing a stitch through the glans (see Fig. 79), so as to hold the organ straight before passing these sutures. The first

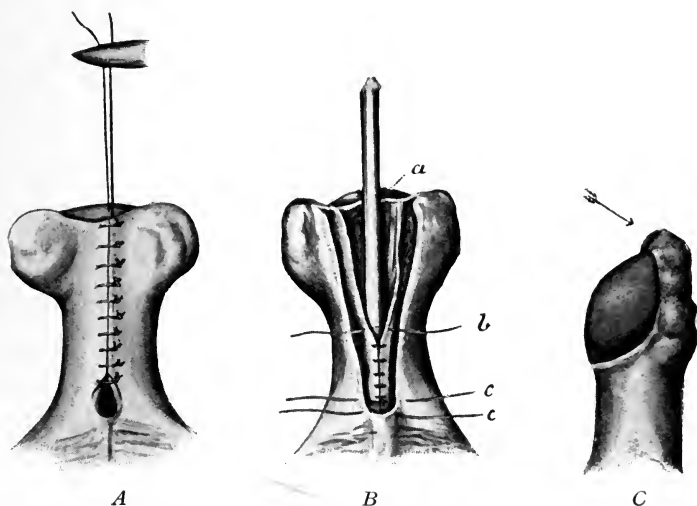


FIG. 80.—URETHROPLASTY FOR HYPOSPADIAS. *A*, The urethral roof formed. The lowest stitch takes up the end of the urethral mucous membrane.

B, Formation of the new urethra. The bougie, *a*, is introduced into the meatus and the new urethra formed around it and fastened by the sutures, *b*. The skin is pulled together over the urethra by the sutures, *c*.

C, Side view of the penis after the urethra has been formed. (Edmunds.)

of the sutures (see Fig. 79, *b*) is placed so as to pick up the point of the shrunken urethra, the next (see Fig. 79, *b'*) passes through the skin on one side, takes a hold on the fibrous tissue in the middle of the raw area and finally emerges through the skin on the opposite side; the remaining sutures are passed similarly, the flaps being brought as far towards the orifice of the urethra as can be done without puckering. It will usually be found that the points *c*, *c'* (see Fig. 79) will be sutured to the raw surface just below the stitch *a*, which has been passed through the glans. The appearance when all these stitches have been passed is seen in Fig. 80, *A*. The remaining raw edges of the prepuce are now stitched to those on the lateral aspect of the glans by a row of sutures. This completes the second stage of the operation, and, when the wounds

have healed, it will be found that the penis is perfectly straight and considerably broader, especially in the region of the glans.

Third stage.—At least another three months should be allowed to intervene before commencing this stage of the operation, which is carried out almost exactly as in Duplay's operation. A soft rubber catheter (about a No. 6 English) is passed into the urethra and stitched to the middle line of the glans; this steadies the organ and facilitates the rest of the operation. An incision is made on each side of the urethral channel, extending into the connective tissue, and sufficiently distant from the sides of the catheter to allow the flaps to be brought together over it (generally about $\frac{1}{4}$ inch), and the flaps so formed are then sutured around the catheter; the skin on the outer side of these incisions is then pulled inwards until its cut edges meet in the middle line, when they are united over the flaps covering the catheter by another row of stitches (see Fig. 80, B). At the anterior part care should be taken to make the incisions run slightly outwards, so as to make the floor of the urethra slightly longer than the roof in order to allow for shrinkage.

The operation is now finished, and the appearance of the penis is that of an organ which has been circumcised, and has a rather redundant mass of tissue below the frenum (see Fig. 80, C). If everything heals satisfactorily the whole procedure is completed, except that there

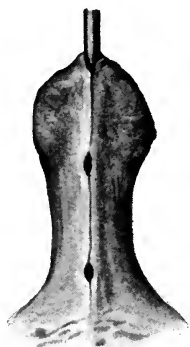


FIG. 81.—URETHROPLASTY FOR HYPOSPADIAS. *Fistulae that may result from failure of union.* (Edmunds.)

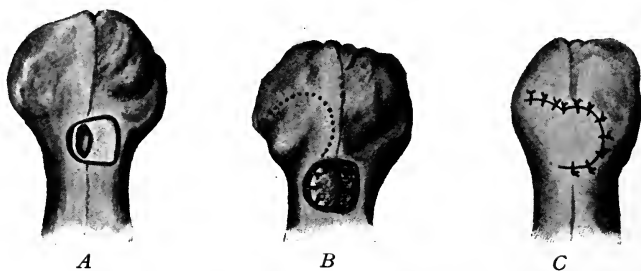


FIG. 82.—URETHROPLASTY FOR HYPOSPADIAS. *Closing defects after operation.* A, shows the flap raised from one side of the opening. B, shows the opening closed by reflecting this flap; and C, shows the skin-flap (shown by the dotted line in B) sutured over the raw area. (Edmunds.)

will usually be a few rather unsightly tags of skin at the side of the glans, which can be clipped away if desired, but this should never be done until sound union has been obtained, as these tags will prove valuable if it should be found necessary to perform any further plastic operation for closing a fistulous opening.

Fistulae not uncommonly occur, either at the junction of the body

of the penis with the glans or just in front of the scrotum (see Fig. 81), and they are best closed in the manner shown in Fig. 82. An incision is made round the fistula (see Fig. 82, *A*), which is not symmetrically

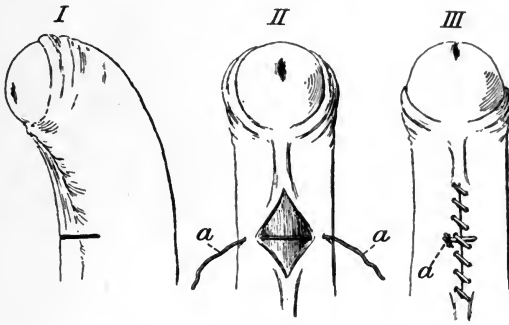


FIG. 83.—AN ALTERNATIVE METHOD OF RECTIFYING THE INCURVATION OF THE PENIS IN HYPOSPADIAS. *I*, Transverse incision across the fibrous band holding down the organ. *II*, Conversion of this incision into a lozenge-shaped space after free division of the band and forcible straightening of the organ; *a* is the first suture introduced, and brings the horizontal angles of the lozenge together. *III*, The incision completely sutured.

placed with regard to the fistulous opening, but is farther away from it on one side than on the other, so that a flap is raised which can be

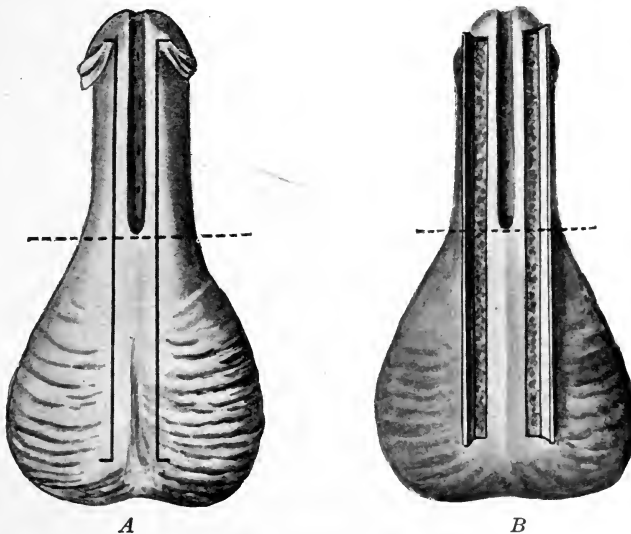


FIG. 84.—URETHROPLASTY FOR HYPOSPADIAS. *Raising the flaps.* *A*, shows the incisions; and *B*, shows the flaps actually raised. The dotted line is the level of the meatus, and is where the penile portion of the urethra is folded down upon the scrotum. (Modified from Bucknall.)

turned over the opening and sutured in position (see Fig. 82, *B*). The free edge of the flap should be longer than the fistulous opening so as to allow for shrinkage and for the insertion of sutures. When the flap has been

fastened in position, a raw surface is left, which is closed by sliding in a rounded flap (see Fig. 82, C), and suturing it in position. This flap

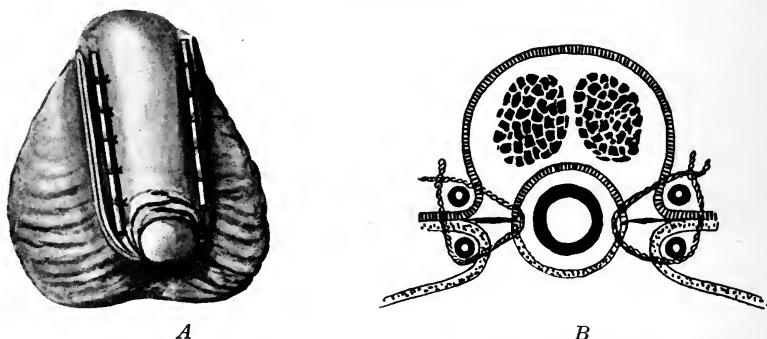


FIG. 85.—URETHROPLASTY FOR HYPOSPADIAS. *Forming the new urethra.* A, shows the penis applied to the surface of the scrotum, the two lateral flaps bent upon one another, and their opposed surfaces fastened by sutures passing over a rubber rod. B, is a diagrammatic cross-section to show how the sutures are inserted. The large continuous circle represents the catheter; the wall of the urethra above it is formed by the skin lining the original urethral groove; the wall of the urethra below it by the skin of the scrotum. The four small black circles represent the rubber rods or catheters over which the sutures are tied as shown in the diagram. (Modified from Bucknall.).

will usually be composed of the redundant tissue on one side of the glans. In the case of fistulæ in front of the scrotum, double flaps are cut as before, but the second flap is derived from scrotal tissue.

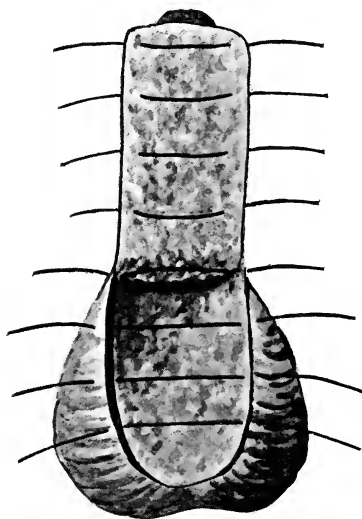


FIG. 86.—URETHROPLASTY FOR HYPOSPADIAS. *Straightening the penis.* The adherent penis is raised from the scrotum by raising it with the large flap shown in the figure. The sutures are inserted to show how all the raw surface may be covered in.

Fine chromicised catgut is best for the sutures, except for the skin, for which horsehair is preferable. The parts are extremely delicate, and it is therefore necessary to use fine needles — preferably, ordinary sewing or curved intestinal needles. Accuracy in suturing is indispensable, and it is important to get a good hold on the skin-flaps so that the stitches will not cut out when the parts are moistened with urine.

Strips of moist boric lint wrapped round the organ, and changed as often as they become soiled with urine, are probably the most satisfactory dressings. There is no particular advantage in keeping a catheter tied in, and it may set up

urethritis and exert tension on the stitches, while it does not always succeed in keeping the wound dry, as urine may escape beside it.

The method of straightening the penis, described in the second stage of the preceding operation will be found to be the most convenient and satisfactory in the majority of cases. When, however, the prepuce is deficient, or unsuccessful operations have been previously performed, it may be necessary to accomplish the straightening by a simple division of the tight bands, either subcutaneously or through an open operation, in which case the edges of the incision must be sutured in the long axis of the penis as shown in Fig. 83.

The method described by Bucknall (see Figs. 84-86) is very useful in cases in which the urethra opens just in front of the scrotum and there is no extreme downward curvature of the penis. It is done as follows:

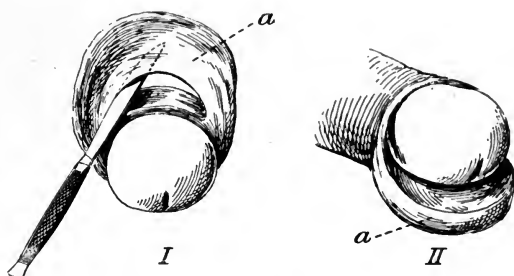


FIG. 87.—METHOD OF UTILISING THE PREPUCE IN URETHROPLASTY FOR HYPOSPADIAS. The hood or flap of prepuce, *a*, is first put on the stretch and transfixed. Subsequently the glans penis is passed through the hole thus made, and the flap of prepuce occupies the situation shown in *II*.

Two parallel incisions are made, one on each side of the urethral groove, extending from the urethral orifice to the glans and a slightly farther distance back on to the scrotum (see Fig. 84, *A*). At each end of these incisions a short cross-cut is made outwards so as to mark out two long narrow flaps, which are then dissected up and turned outwards, leaving a long strip of skin and mucous mem-

brane, with the opening of the urethra above its centre (see Fig. 84, *B*). A rubber catheter is passed into the urethra, and the penis turned down on to the scrotum so that each lateral flap is folded upon itself at the level of the urethral orifice. Stitches are then passed so as to bring together the edges of the two halves of each strip, and so complete the new urethra; the same stitches also approximate the raw surfaces external to the new urethra. These stitches are

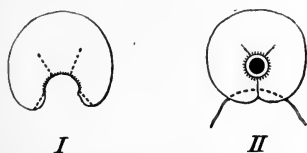


FIG. 88.—RESTORATION OF THE URETHRA IN THE GLANS PENIS IN A CASE OF HYPOSPADIAS. *I*, The upper pair of dotted lines indicates the incisions into the substance of the glans. The lower pair are for rendering the edges raw, so that they may be approximated, as in *II*.

tied over a piece of fine rubber tubing laid along each side of the penis both on the dorsal and ventral aspect (see Fig. 85, *A*). The arrangement of the suture is seen in the diagrammatic cross-section, Fig. 85, *B*. When the wound has soundly healed, a U-shaped incision is made in the scrotum about half an inch away from the penis all round, and the latter is then dissected up, giving the appearance shown

in Fig. 86. The raw surface of this flap is then folded on itself so as to cover the ventral aspect of the penis with skin, and the wound in the scrotum is closed with a row of sutures. The terminal portion of the urethra is completed at a subsequent operation, either by turning over the prepuce, if there is enough of this structure left (see Fig. 87), or by some other means, such as that shown in Fig. 88.

EPISPADIAS.

This deformity is the reverse of hypospadias; the upper wall of the urethra being deficient. It is much rarer than hypospadias and; although

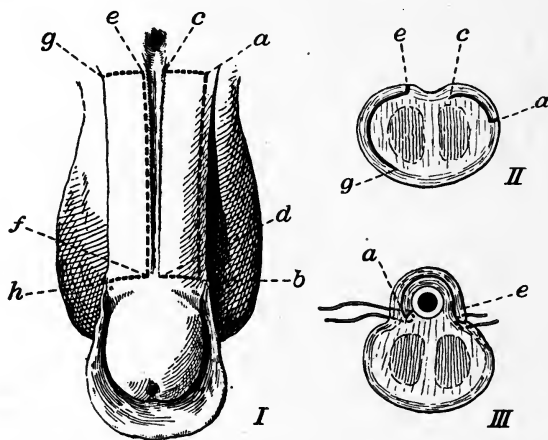


FIG. 89.—THIERSCH'S OPERATION FOR EPISPADIAS. *I*, Incisions for raising two flaps, *abc* and *efg*. *II*, The direction in which the flaps are raised; *ac* represents the flap, *abc*, and *eg* the flap, *efg*. *III*, Method of reflecting and suturing the flaps. The edge, *a*, of the flap, *ac*, is sutured to the point, *e*, in *II*, while the edge, *e*, of the flap, *eg*, is sutured to the point, *a*, in *II*. This diagram also shows how buried sutures are avoided, and yet the flaps are properly secured.

the cleft may be limited to the anterior part of the urethra; it commonly extends into the neck of the bladder and is usually associated with ectopia vesicæ (see p. 426). In the complete form of the affection, true incontinence of urine is present, but when the cleft is limited to the anterior part of the urethra, the patient may retain control of the urine. The penis is usually curved upwards by fibrous bands passing from the symphysis pubis to the middle line of the dorsum of the penis, and the patient suffers from even more disability than in the corresponding degree of hypospadias.

TREATMENT.—This resembles that for hypospadias. The slighter forms of the deformity, in which the urethra is cleft only where it passes through the glans, do not call for operative interference. In the more

extensive cases, in which the penile urethra is affected but the neck of the bladder is intact, operations upon lines similar to those for hypospadias may be practised.

The operation is done in stages, as in the case of hypospadias, the penis being straightened in the first instance, the urethral canal then restored, and finally united to the opening at the root of the penis. When extroversion of the bladder is also present, the treatment of the cleft urethra must be delayed until the ectopia has been remedied (see p. 426).

The straightening of the re-curved penis is done exactly as for hypospadias (see p. 326), but in this case the organ must be fastened down during healing, and the best plan is probably to employ the wire frame recommended for retained testis (see p. 287), and to fasten the organ to it by means of a stitch through the frenum. This apparatus can be worn even when the patient gets about, and the movements of the limbs do not interfere with the wound. This is a better plan than stitching the organ to the skin of the thigh.

Thiersch's method.—The restoration of the penile urethra is best done by the method introduced by Thiersch, which differs somewhat from that described for hypospadias. The method will be evident from the diagrams (see Fig. 89). A flap is fashioned on each side of the urethral groove, by means of vertical incisions parallel to its margins. On one side the incision, *ef*, is made parallel and close to the side of the urethral groove; and at each end transverse incisions are carried outwards; this flap is then dissected up and turned outwards. On the other side the vertical incision *ab* is made at a sufficient distance from the urethral groove, so that when the flap is turned in, it shall completely cover the groove, and from its ends transverse incisions are carried inwards to the groove; this flap is then dissected up and turned inwards, so that its cutaneous surface forms the roof of the urethral canal, and its edge is fastened to the raw surface from which the other flap has been raised. The other flap, which should be considerably larger than the first, is then pulled in over the latter so that the two raw surfaces are in apposition; its cutaneous surface therefore forms the cutaneous covering of the dorsum of the penis. The diagram (see Fig. 89, *III*) will serve to show how the sutures are inserted; it is important not to bury any, as the asepticity of the wound cannot be guaranteed; they are therefore so arranged that they are tied outside and can be removed easily. The urethra is formed over a rubber catheter of suitable size, as in hypospadias. At the same operation, the small triangular interval between the urethra in the glans and the newly formed penile one is closed by utilising the prepuce in a manner very similar to that described for hypospadias (see Fig. 87). The urethra in the glans penis may be restored at the preliminary operation of straightening the organ.

The final stage consists in connecting the proximal end of the new urethra with the bladder, and for this purpose Thiersch uses flaps fashioned as shown in Fig. 90. The edges of the defect are pared and the first flap (*a*) is turned with its epithelial surface downwards so as to lie in the triangular space, to which it is stitched. The second flap is made to cover the raw outer surface of the first. The raw surfaces from which the flaps are raised may be allowed to heal by granulation or can be skin-grafted. The difficulty about this operation is to secure union if urine is allowed to pass along the new urethra before healing

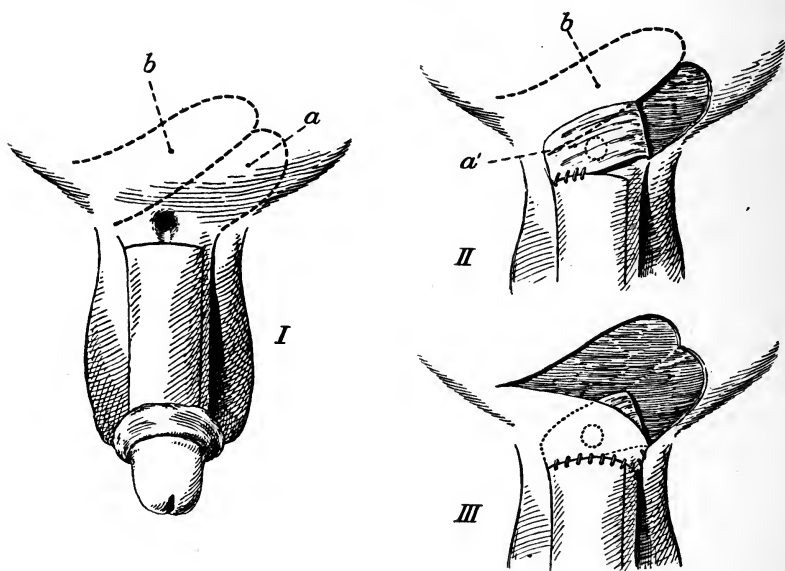


FIG. 90.—THIERSCH'S OPERATION FOR EPISPADIAS. This shows the final stage, in which the new urethra is connected with the orifice at the neck of the bladder. *I*, shows the two flaps, *a* and *b*, marked out. In *II*, the flap, *a*, is reflected and sutured to the pared edge of the new urethra, so that its raw surface is outside. In *III*, this is covered in by the flap, *b*, which has its cutaneous surface outside.

is complete, and the best plan is therefore to make a button-hole opening in the perineum, insert a tube through it into the bladder, and drain the organ in this manner for the first five or six days. The tube is left out when union of the flaps is complete and the perineal opening is allowed to close.

The chief objection to this part of Thiersch's operation is that the reflected flap carries with it hairs which grow into the urethra and may cause trouble from the deposition of phosphatic concretions upon them. Radium or X-rays should therefore, in the first instance be employed so as to depilate the part; the depilation, however, is often only temporary.

The method may be advantageously modified by sliding a flap in from one side, with its raw surface looking downwards, instead of using the superimposed flaps mentioned above. The deeper surface of this flap, which should be of large size, naturally granulates and contracts, but if it is made large enough in the first instance, no constriction of any consequence is produced ; indeed, any slight narrowing that may occur is probably beneficial to the patient in allowing him to obtain some sort of control over the urine and in preventing the constant dribbling which is such a distressing feature of ectopia vesicæ.

CHAPTER XXXIII.

INJURIES OF THE URETHRA.

OWING to its protected position, the urethra is not often the seat of penetrating wounds, but these may occur if the patient falls astride a sharp object. The most common injuries are contusions or rupture of the urethra without a wound of the skin. Damage done to the urethra by the passage of instruments is more appropriately dealt with in connection with stricture of the urethra (see Chap. XXXVII.).

PUNCTURED AND INCISED WOUNDS.

Punctured wounds usually only require simple dressing. Healing is rapid and satisfactory, and the cicatrix does not give rise to trouble from contraction.

The treatment of *incised wounds* varies according as they are parallel or transverse to the long axis of the urethra. In the former case the wound does not gape, and it is merely necessary to clean it up and see that the opening in the skin is sufficiently free for drainage; catgut sutures may be used to keep the edges of the urethra together, but they should not penetrate the mucous membrane. The patient is allowed to micturate naturally. In these cases there is little tendency to subsequent stricture as the cicatrix is in the long axis of the canal.

If, however, the wound is transverse or oblique to the long axis of the urethra, a stricture will occur unless the cut edges are accurately united. A full-sized sterilised red-rubber catheter should be passed into the bladder, if possible—or at any rate down to the seat of the injury—and then the urethra should be exposed by a free longitudinal incision through the soft parts over it. The cut edges of the urethra are identified and accurately united with fine absorbable catgut, the urethra being freed if necessary so as to allow the edges to come together without tension. The sutures should be passed in Lembert's fashion, avoiding the mucous membrane; the soft parts superficial to the urethra, and the wound in

the skin should be sutured separately, room being left for the introduction of a drainage tube, so as to allow any urine to escape. The catheter should be retained for twenty-four hours, after which time the patient is allowed to micturate naturally; if the wound has been accurately sutured there is little risk of its being burst open during micturition. It is well to administer bromide of potassium (gr. xxv) and chloral (gr. x) every evening, three hours before bedtime, in order to prevent erections, which might interfere with union. The cicatrix is small if the urethra has been accurately sutured, and there is little tendency to subsequent stricture. It is well, however, to pass a bougie—at any rate for the first two years—at intervals, gradually increasing from three days up to three months or more, so as to make sure that no stricture occurs. If it does, the case should be treated as one of stricture of the urethra (see Chap. XXXVII.).

CONTUSIONS AND RUPTURES.

Contusions of the urethra most commonly follow falls astride of an object, such as a rail or a beam; they may also be due to kicks or direct blows upon the perineum, and very often complicate fractures of the pelvis. More rarely they are the result of slight violence—for example, after erections in a patient suffering from chordee; in the latter cases the injury occurs only in the penile portion, and is referred to in connection with gonorrhœa (see Chap. XXXV.).

The injury to the urethra in these accidents usually occurs near the junction of the membranous with the bulbous portion. When the rupture complicates a fracture of the pelvis, the membranous or, more rarely, the prostatic urethra is lacerated. In falls astride, the injury is produced by the urethra being crushed against the edge of the pubic arch, in the majority of cases, the patient striking the obstacle somewhat sideways; in others, however, the membranous urethra may be torn across without any actual pressure against the bone.

The extent and nature of the injury vary in different cases. In some the spongy tissue outside the mucous and submucous coats is the chief structure damaged, and a large diffuse hæmatoma may occur in this region. In the more severe injuries, however, the submucous tissue and the mucous membrane are torn. In the most severe forms the urethra is torn completely across, and this is most likely to happen when the injury occurs in the membranous portion. The chief dangers in these cases are retention and extravasation of urine.

When the urethral mucous membrane is intact, the main *symptoms* are a hæmatoma in the perineum, accompanied by a certain amount of pain. If the hæmatoma is large, its pressure upon the urethra may interfere with micturition. In the majority of cases, however, the mucous membrane is lacerated, and blood escapes from the meatus, varying in

amount according to the site and extent of the injury ; when this escape of blood occurs independently of micturition it is pathognomonic of a ruptured urethra. When the urethra is torn, the perineal swelling is generally large, and attempts at micturition are accompanied by a sharp cutting pain in the perineum and an increase of the existing swelling owing to extravasation of urine. The act of micturition is always difficult ; when the urethra is completely divided no urine is passed.

The after-progress of the case varies with the seat and degree of the injury. When there is merely a contusion of the urethral mucous membrane, there is usually little trouble beyond a tendency to retention of urine. When, however, the urethral wall has been torn, there is always the risk of septic complications and when the extent of the laceration is considerable, these complications are practically certain to occur. The blood passing down the urethra furnishes a nidus whence bacteria spread rapidly up to the seat of injury and lead to septic complications. Septic infection may also occur as a result of the introduction of a catheter.

When the mucous membrane has been torn, the most serious complication is extravasation of urine. When the patient attempts to micturate, urine passes through the gap in the urethral mucous membrane into the tissues around and, as infection quickly occurs, symptoms of acute septic urinary infiltration arise. In other cases the urine may not penetrate into the tissues in the first instance, but when the latter have become softened as a result of the septic process, the urine finds its way into them at a later period. This constitutes the so-called 'late' extravasation of urine.

After recovery, a traumatic stricture is left which is more difficult to treat than the ordinary stricture resulting from disease.

TREATMENT.—(a) **Of recent cases.**—When a patient has ruptured his urethra, he generally experiences a desire to micturate, and, should the surgeon see a case of pelvic injury immediately after its occurrence, he should always caution the patient not on any account to attempt to pass water until the condition of the urethra has been ascertained. Frequently, however, the patient has already made the attempt, and actual extravasation of urine has occurred before the surgeon sees the patient. The diagnosis of the injury is generally easy, as the blood flowing from the meatus renders it quite evident that not only has the urethral mucous membrane been torn, but also that the submucous and spongy tissues have been damaged. It is important, however, to ascertain the precise condition of affairs in the urethra, and this should be done immediately ; even when the case is one of fracture of the pelvis the treatment of the rupture of the urethra must be carried out before that of the fracture of the pelvis.

The condition of the urethra is ascertained by passing a sterilised semi-rigid catheter, with all the precautions as to disinfection mentioned on p. 374. The blood should be squeezed out from the urethra as

completely as possible before the instrument is passed. It is best not to use the ordinary soft catheter, as the surgeon has no command over the direction in which its point goes and will gain little information; an instrument with a stylet bent to the ordinary urethral curve is better. In order to pass the instrument into the bladder, the surgeon must take care to keep the point well in contact with the roof all the way, and if he succeeds, the urine is at once drawn off and the instrument tied in. The appropriate treatment for any other injury present may then be proceeded with, but, should the attempt to pass the catheter be unsuccessful, further steps must be taken to empty the bladder before that is attended to.

When the bladder is distended, some surgeons prefer to aspirate it above the pubes at once before attempting to pass a catheter. This is quite right when the surgeon is not prepared to proceed immediately with the repair of the urethra or when the patient is so collapsed as to be unable to stand operation; it is, however, not advisable as a routine method. Some surgeons, however, advocate aspiration of the bladder above the pubes at regular intervals for several days, without interfering with the urethra, so as to allow the wound in the latter to heal. This plan we do not advise.

Various views are taken as to the best way of dealing with the injury to the urethra. One line of procedure that is advocated is that, when a catheter can be passed easily, no operative interference should be practised, an instrument being merely passed at regular intervals to draw off the urine; that, when catheterisation is difficult, but still possible, an instrument should be tied in for some days; and that, when catheterisation is impossible, external urethrotomy should be performed.

As regards the first point, we have already mentioned that serious consequences—such as abscess formation—may arise from infection of the clot effused into and around the urethral walls quite apart from the trouble due to extravasation of urine, and mere evacuation of the urine by a catheter does not prevent this. Indeed, the passage of a catheter is very apt to lead to such infection, and, when instruments are passed repeatedly, septic material will almost inevitably be introduced at some time or other and will probably lead to the inflammation which it is so desirable to avoid. We are therefore of opinion that unless the injury to the urethra is very slight—not more than an abrasion of the mucous membrane—it is not safe to depend on the passage of catheters at definite intervals. When, however, there is reasonable ground for believing that the injury has only affected the mucous membrane and has not led to rupture of any other part of the urethral wall, this line of treatment may be adopted, and the urine may be drawn off every six hours for three or four days, and then the patient may be allowed to micturate voluntarily. In carrying out this line of treatment it is essential that every precaution with regard to disinfection of the instruments (see p. 374) should be scrupulously employed. Moreover,

bacteria may spread up the urethra when blood is constantly escaping from it, and, as infection may therefore occur quite apart from the passage of the catheter, it is most important that the urethra should be treated just as any other wound, and an antiseptic dressing applied over its orifice; the penis should be kept wrapped up in a bag of antiseptic dressing and the meatus should be mopped out and disinfected (see p. 374) immediately before an instrument is passed.

When, however, the wall of the urethra has been torn, the problem is a much more serious one. To tie in a catheter in these cases is unadvisable, as it is practically impossible to prevent sepsis spreading up the urethra alongside the instrument, however carefully the latter be disinfected or however clean the orifice of the urethra be kept. It has been found as a matter of experience that, of the three methods of treatment indicated above, the cases treated by tying in a catheter have presented the greatest mortality, and this is only what might be expected, since the presence of the catheter, while it may prevent extravasation of urine, cannot prevent infection of the wound in the urethra and the tissues around. Moreover, it is very likely to set up irritability of the bladder and then, notwithstanding the continuous drainage, a few drops of urine are apt to pass down alongside the catheter and so reach the wound; although the urine is not under any pressure and, if aseptic, may do no harm, it furnishes additional pabulum for bacteria, and is therefore apt to increase the septic condition.

Hence, in our opinion, the surgeon has only two alternatives in the treatment of these injuries: on the one hand the passage of a catheter at intervals, and on the other external urethrotomy; considering the great value of the latter method, we see no reason for looking upon it as a last resort. As a matter of fact, the mortality in cases treated in this way is less than in any other, whilst its advantages are numerous. In the first place, it opens up parts infiltrated with blood, so that free exit is given to the discharge and the chances of septic infiltration are lessened. It may, indeed, be urged as an objection to this operation that sepsis will probably occur in the wound, and this is no doubt true, as it is difficult to prevent infection in this situation; but it must be borne in mind that it is even more difficult to prevent infection of the tissues *per urethram* when a catheter is tied in, and that a subcutaneous infection is much more serious than one in an open wound which is freely drained. A second great advantage of immediate urethrotomy is that the urethra can be repaired forthwith, so that more rapid and perfect healing is obtained, with a corresponding diminution in the extent and severity of the subsequent stricture; indeed, the stricture may be quite slight if the urethra has been incompletely divided at the time of the accident and if the rent in it is accurately sutured. This advantage is lost if time is allowed to elapse and the wound has to be opened up at a later stage on account of septic infection or urinary infiltration, as, apart from

the sloughing which will probably have occurred in the tissues by that time and which renders the repair of the urethra impossible, there is the further difficulty that the ends of the urethra will be firmly imbedded in lymph and cannot be approximated and sutured as they can in a recent case. Moreover, the ends of the urethra themselves are beginning to granulate and will be too soft to hold sutures.

For these reasons, we strongly advise that, whenever there is evidence of injury to the urethral wall, and *a fortiori* when the symptoms point to the latter being torn partially or completely across, an immediate external urethrotomy should be performed and means taken to suture the rent in the urethra. The procedure is carried out as follows :—

The patient is anaesthetised, placed in the lithotomy position, and the perineum shaved and disinfected. It is advisable not to empty the bladder immediately before the operation, as the presence of urine in the organ may assist in identifying the proximal end of the torn urethra (*vide infra*). A median incision is made from the root of the scrotum to within half an inch of the anal orifice and is deepened in the middle line through the contused structures. A full-sized metal bougie is passed down the urethra to the seat of rupture, and its point is then exposed in the perineal wound. The incisions in the soft parts must be free, and the various layers should be divided to the same extent as the skin, so that the state of matters may be seen clearly ; a powerful electric light may be required.

The end of the instrument protruding through the torn urethra will lead to the identification of the distal end of the urethra, but if the latter is completely torn across, the recognition of the proximal end is not always easy, as the parts are frequently much obscured by the infiltration of blood. The best plan is to flush out the wound with warm normal saline solution. If the stream of fluid is projected fairly forcibly into the wound, the clots are washed out and the torn proximal end of the urethra may be seen projecting somewhat from the surrounding parts and floating in the fluid. If this manœuvre fails to identify the torn end, no time should be wasted in searching with a probe, but the assistant should make pressure over the bladder above the pubes whilst the surgeon with a probe in his hand watches for the escape of urine from the wound. As the urine escapes, its point of exit can be seen and a probe introduced into the proximal end of the urethra. The next step is to pass a full-sized sterilised red-rubber catheter down through the meatus, and, when the end emerges from the distal end of the urethra, the margins of the proximal end around the probe are seized and steadied in forceps and the point of the catheter is insinuated along the probe into the bladder. When this has been effected, the torn ends are approximated and sutured. When the laceration is irregular, accurate suturing may be impossible ; but even if only two or three stitches can be inserted, the subsequent stricture may be considerably diminished. The

sutures, should be of the finest absorbable catgut, and, although theoretically they should not include the mucous membrane, it is practically impossible to avoid doing this, and it is not really a matter of much importance.

It may, however, be impossible to identify the proximal end of the urethra in this manner, especially when some days have elapsed between the date of injury and the operation. Under these circumstances, a supra-pubic cystotomy should be performed (see p. 473), and an instrument passed from the bladder down through the urethra so that its point emerges in the wound from the torn end of the proximal portion, which is thus identified. A probe is then passed from the perineal wound into the bladder along the instrument; the latter is withdrawn, and the surgeon insinuates a catheter from the meatus into the bladder in the manner described above. If this should fail, a procedure that we have tried with success may be adopted. A silk thread is tied tightly around the end of the instrument that has been passed from the cystotomy wound through the neck of the bladder, and the other end of the thread is passed through the eye of the catheter which is inserted through the penile portion of the urethra. The instrument is then withdrawn from the bladder through the supra-pubic opening, carrying with it the silk thread. Traction on the thread will then pull the catheter in the penile urethra towards the bladder, and gentle manipulations of its point will generally enable it to pass along the proximal portion of the urethra into that organ. The subsequent steps for the repair of the urethra are the same as before.

Should the urethra be only partially divided, the rent may be repaired accurately with fine catgut, and then the outlook is good; little stricture, if any, is likely to result.

If it should be impossible to stitch the ends of the urethra together, as sometimes happens, the catheter must be tied in for some days and the wound allowed to heal by granulation.

The simplest *method of tying a catheter into the bladder* is to wrap a narrow piece of strapping around the catheter about half an inch in front of the meatus, leaving an end long on each side. The instrument is then covered with boric lint between the strapping and the meatus, and the lint is made to cover the glans penis, over which the prepuce is pulled forward, and then the ends of the strapping are applied on each side of the penis and kept in position by a narrow strip wound horizontally around the organ behind the corona. Care must be taken not to fasten this circular strip too tightly; should it cause any inconvenience, the tension can be overcome by slitting it up on the dorsum. Another plan is to fasten the catheter by means of four threads (see Fig. 91) to loops of tape passed round the thighs and secured to an abdominal bandage. When a catheter is tied in, it is very essential that its point should not project too far into the bladder. The best way to ascertain the proper

distance is to pass the catheter on until the urine flows freely and then to withdraw it slowly until the flow of urine just ceases ; the instrument is then pushed back a quarter of an inch and tied in position. This will leave the eye just within the neck of the bladder.

In all cases it is best to leave the perineal wound open ; a small drainage tube should be introduced through it down to the rupture in the urethra, and the wound lightly packed with iodoform gauze for two or three days. The sides of the wound fall together when the legs are placed in the horizontal position and tied together, and there is no necessity for stitches ; indeed, the insertion of sutures in this situation might lead to septic infiltration. A large antiseptic dressing is applied over the perineum, and the catheter, which is tied into the bladder (see p. 342),

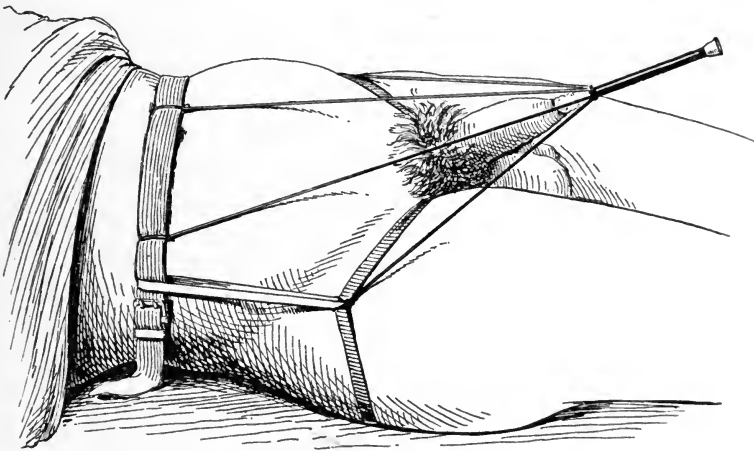


FIG. 91.—A METHOD OF TYING A CATHETER INTO THE BLADDER. The figure shows how the tapes are arranged around the abdomen and thighs, and the threads are attached to them.

is fitted with india-rubber tubing, and the end of this is carried into a basin of boric or carbolic lotion ; in this way continuous drainage is insured. The practice of plugging the catheter and occasionally removing the plug for the purpose of emptying the bladder is not good, as urine is apt to escape alongside the instrument as the bladder fills up.

After-treatment.—The catheter is left undisturbed for about four days, when it is removed and a fresh, carefully sterilised instrument is substituted. This should be of a somewhat smaller size ; if a No. 12 instrument has been employed in the first instance, the next size introduced should be a No. 10, and this should be kept in position for two days, when it is removed and another instrument of the same size substituted. For the first fortnight it is well to keep a catheter constantly in the bladder, but after that time the patient may be allowed to micturate naturally, and an instrument should be passed every three days to prevent contraction.

For this purpose Lister's bougies (see Fig. 103) should be used. In the first instance they should be passed every third day for several weeks; the interval is then gradually increased if no contraction seems to be taking place. First a week, then two, three, or four weeks may be allowed to elapse between each sitting, but the patient must be cautioned that for the rest of his life he is liable to contraction of the stricture and that, should this once become well developed, it is very difficult to treat; he must therefore always be under observation and may require to have an instrument passed at least once in three months for the rest of his life.

The external dressings should be changed every twelve hours or oftener if they become soiled; the gauze packing put in at the time should be removed at the end of two or three days and need not be renewed. The perineal drainage tube should be left undisturbed for four days, when it may be dispensed with. The perineal wound should then be left alone, merely external dressings being applied over it. The bowels should be kept confined for four or five days by laudanum, and salines should then be administered so as to obtain liquid motions without straining. The external dressing should be removed just before each act of defæcation and a piece of gauze wet with 1 in 2000 sublimate solution kept over the perineal wound during the act; when the act is completed, the parts should be washed with 1 in 20 carbolic solution, followed by 1 in 2000 sublimate lotion, and the external dressing renewed. The wound should follow an aseptic course and heal in three or four weeks.

(b) Of cases seen at a later period.—When some days have elapsed before the patient comes under the surgeon's notice, or when operative procedures have not been undertaken in the first instance but are called for after the lapse of some time on account of the occurrence of sepsis, the procedure is practically the same, *i.e.* perineal section is performed and a catheter introduced into the bladder from the meatus; there is, however, no possibility of suturing the rent in the urethra. After the catheter has been tied in position, a drainage tube should be introduced down to the seat of injury, and the wound packed for two or three days, the after-treatment being carried out as above described.

The treatment of extravasation of urine, whether immediate or of some standing, is discussed in Chap. XXXVI.

CHAPTER XXXIV.

FOREIGN BODIES IN THE URETHRA : URETHRAL CALCULUS.

FOREIGN bodies in the urethra may be either introduced through the meatus or come down from the bladder or prostate. Of those introduced through the meatus the most common are portions of catheter broken off from a faulty instrument, pencils, bonnet-pins, or pieces of wood. A broken-off portion of catheter generally lodges in the deep urethra, but the other foreign bodies of this type are usually met with in the front half of the penile portion. Those which come from above are calculi of various kinds. They may lodge in the fossa navicularis, in the penile portion, or at the junction of the membranous with the prostatic urethra. The stones usually come from the kidney, and are small rounded or ovoid bodies. In other cases they may consist of small portions detached from a larger stone in the bladder, and they are then sharp and irregular, and may cause much trouble from impaction. Prostatic calculi may also escape into the urethra. Impaction of a calculus in the urethra is of common occurrence in children ; sudden retention of urine in a little boy is almost invariably due to this cause.

The presence of a foreign body in the urethra leads to partial or complete interference with the passage of urine, and if present for some time it causes urethritis, especially if impaction has occurred. The history is usually sufficient to lead to a correct diagnosis. The patient is generally seized with a sudden sharp pain on micturition accompanied by stoppage of the flow and followed by partial or complete retention ; if the urine can pass alongside the stone, the urinary stream is feeble and broken up. Profuse urethritis with blood-stained pus often occurs after impaction has lasted for some time. When the calculus is sharp and is impacted in the urethral mucous membrane, there may be oozing of blood from the meatus independent of micturition ; when this occurs without a history of injury and without the presence of gonorrhœa, it is very characteristic of an impacted stone. When the stone is situated in the fossa navicularis it can be felt and may be seen through the meatus. When it is in the penile portion it can be grasped between the

fingers, while, if it is situated lower down in the neighbourhood of the triangular ligament, pressure over it causes a sharp cutting pain.

It is always well to bear in mind that painful micturition followed by urethritis; without any obvious cause, occurring either in children or in elderly subjects, is very likely to be due to this condition, and by passing the largest-sized sound that the urethra will admit, a calculus can generally be detected. In passing a sound for diagnostic purposes, it is important not to use force, otherwise the stone may become more firmly impacted, or laceration of the mucous membrane may be caused; the stone may also be driven backwards into some less accessible portion of the urethra.

TREATMENT.—It is essential to remove the foreign body as soon as possible, either by extracting it through the orifice of the urethra, or by an external incision. Urethritis, retention of urine, urethral abscess, and extravasation of urine may follow if the foreign body is allowed to remain. The exact steps of the treatment are determined by the size, nature, shape, and situation of the body; and the cases met with in practice may be divided into two primary groups—namely: (1) foreign bodies in the penile urethra, which in turn may be divided into (*a*) those in which the foreign body is smooth and unimpacted and (*b*) those in which the body is rough, pointed, or impacted; (2) foreign bodies in the deep urethra.

1. Of a foreign body in the penile urethra.—(*a*) **When the body is smooth and unimpacted**, and especially when it is a stone, a useful plan is to direct the patient to compress the lips of the meatus firmly between the finger and thumb and then to attempt to micturate. The pressure is kept up for a few moments until the urethra becomes distended by the urine and then, if the pressure is suddenly relaxed, the foreign body may be swept forcibly out from the distended urethra along with the urine. This manoeuvre may be facilitated if it is carried out when the patient is sitting in a hot hip-bath. Should it fail, one of the following methods must be adopted.

When the foreign body is lodged in the fossa navicularis it is only necessary to slit the orifice downwards sufficiently to enable the body to be squeezed or drawn out with forceps; the small incision heals without special treatment.

When the foreign body is lying farther down the penile portion, it should be withdrawn if possible along the urethra. The urethral mucous membrane should be anæsthetised by means of a 4 per cent. solution of novocaine, and a urethroscopic tube (see Chap. XXXV.) passed down to the situation of the foreign body, after taking the precaution to compress the urethra immediately behind the latter in order to prevent the foreign body being driven deeper down. The urethroscope enables the surgeon to see the size, shape, and situation of the body, and it may even be possible, when the object is small, to slip the end of the tube

over one end of it, after which the body can be easily seized with forceps introduced through the tube, and removed. If this cannot be done, the urethroscopic tube should be withdrawn and a pair of urethral forceps should be passed down with closed blades until they touch the foreign body, which is prevented from slipping backwards by compressing the urethra behind it. When the foreign body is reached, the blades of the forceps are widely opened and attempts are made to insinuate them between the body and the mucous membrane. If this is successful the foreign body is gently withdrawn. No attempt whatever should be made

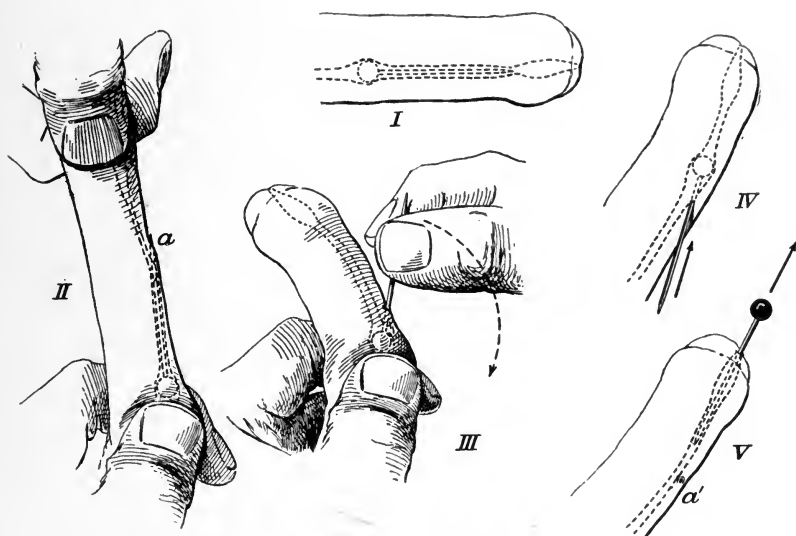


FIG. 92.—THE EXTRACTION OF A PIN FROM THE URETHRA. *I*, The pin lying head downwards in the urethra. *II*, By pressure on the head of the pin, the point, *a*, is driven through the skin. *III*, This is seized, pulled out right up to the head, rotated in the direction of the arrow and then, *IV*, pushed head first up the urethra and, *V*, extracted.

to push the body along the urethra towards the meatus by squeezing the parts from outside, as this is not likely to succeed and may seriously damage the mucous membrane.

If this attempt should prove unsuccessful after a short trial, it should not be persisted in, as the mucous membrane is easily damaged even by the most careful manipulations with forceps. The case should at once be treated as if the body were impacted, and the latter removed by an external incision.

(b) When the body is rough, pointed, or impacted, or when the above treatment fails, removal must be effected through an external incision. The foreign body is readily defined and fixed in position by compressing the urethra behind it when it lies in the penile urethra, and all that is then necessary is to stretch the parts firmly over it and incise

the corpus spongiosum and the urethra in the middle line ; the edges of the incision are retracted and the foreign body is removed. Should the body be a long one, such as a piece of slate pencil, the best plan is to cut down upon one end, which is then seized and the body withdrawn. In connection with objects such as these, the urethroscope may afford valuable information, especially in demonstrating which end is impacted ; the impacted end should always be cut down upon in preference to the other. The urethra is then closed by fine absorbable catgut stitches, and the skin incision should be sutured, except at one point, which is left open for a few days in case leakage of urine should occur. The patient may be allowed to micturate spontaneously.

Occasionally large-headed pins are introduced into the urethra, and these can often be removed without a cutting operation. These bodies are always introduced into the urethra head foremost, and the head of the pin can generally be felt in the penile urethra. This is seized and fixed with the fingers, whilst the penis is stretched and then firmly dorsi-flexed so as to thrust the point of the pin through the urethral wall and skin



FIG. 93.—STRAIGHT, GROOVED STAFF FOR PERINEAL SECTION.

on the under-surface of the penis (see Fig. 92, *II*). The point is now seized and the pin is drawn out as far as it will come, leaving only the head inside the urethra. The direction of the pin is now reversed by rotating the point downwards towards the anus, so as to make the pin lie with its head directed towards the meatus when, by taking hold of the point of the instrument, the head can be pushed along the urethra towards the meatus, through which it is protruded and withdrawn (see Fig. 92, *III—V*).

2. Of foreign bodies in the deep urethra.—In this group of cases the treatment is identical whether the foreign body is impacted or not. The surgeon has to decide whether he will attempt to push the object into the bladder with a large sound and subsequently crush it with a lithotrite, or whether he will perform perineal section at once. Perineal section is to be recommended in most cases as it insures removal without any damage to the delicate prostatic urethra ; this is almost certain to occur if an attempt is made to push the body into the bladder. The latter method is most uncertain even with a small smooth object, and, if attempted, the greatest care should be exercised, and the surgeon must be ready to cut down at once if the attempt fails.

The cutting operation is very simple, and takes the form of a median perineal section. A blunt-ended straight staff with a median groove (see Fig. 93) is passed down until it rests in contact with the foreign body, and is then made prominent in the perineum by carrying the handle somewhat

upwards towards the abdomen. An incision is made in the middle line of the perineum over the instrument ; this incision should be from an inch to an inch and a half long and terminates about half an inch in front of the anus. The urethra is opened by cutting upon the end of the groove, the edges are seized with catch-forceps and held aside, and the instrument withdrawn ; the foreign body can generally be seen by the aid of a good light, and may be grasped in forceps and removed without any damage to the urethral mucous membrane. The urethral incision may be left to close spontaneously, or it may be approximated by a few fine catgut sutures. We prefer the latter method, and do not leave a catheter permanently in the bladder, but pass a No. 8 gum-elastic instrument every six hours for the first two or three days so as to draw off the urine. This can be done without risk to the union of the incision in the floor of the urethra if care be taken to keep the point in constant contact with the roof as it is passed along the canal. No sutures are inserted in the skin-wound ; an antiseptic dressing is merely applied over it, and after the third day the patient may be allowed to micturate naturally.

CHAPTER XXXV.

INFLAMMATORY AFFECTIONS OF THE URETHRA.

INFLAMMATIONS of the urethra may be divided into two great groups: namely, venereal and non-venereal urethritis; the former being far the commoner form.

GONOCOCCAL URETHRITIS.

This is the name given to venereal urethritis due to a specific organism—the gonococcus of Neisser. This is a small coccus which occurs in pairs or groups of pairs, the opposed surfaces of the cocci being somewhat flattened. In the urethra the gonococci are present in the substance of the mucous membrane and in the epithelial cells. In the discharge they are found especially in the pus cells, some of which are crowded with the cocci during the acute stage. They occur also outside the cells, but in fewer numbers. They stain readily with aniline dyes, but are decolorised by Gram's method, and they may be cultivated, although with some difficulty, outside the body.

Other organisms are often found in gonorrhœal pus, but the gonococcus has been clearly shown to be the specific cause of the disease, the others being of secondary importance, although they may help to keep up the inflammatory condition. Among these are the ordinary pyogenic cocci, and it is probably to them rather than to the gonococcus that suppurative complications, such as suppurating bubo, are due.

The gonococcus especially attacks the urethral mucous membrane, but it may grow on the rectal or buccal mucous membrane to a slight extent; it flourishes well on the conjunctiva. It may be carried to other structures, such as the various synovial or serous membranes, and set up inflammation in them. It is very difficult to extirpate the gonococcus from the male urethra, and in women it may remain for a long time more or less dormant in the folds of the mucous membrane of the cervix uteri under certain circumstances.

Great care is necessary in diagnosing a case of urethritis as gonococcal,

because there are various other causes of purulent urethritis ; before any case is pronounced to be gonococcal with sufficient certainty for medico-legal requirements, the gonococcus must be recognised in the discharge both by microscopical examination and by cultivation. It is equally important that great care should be taken in pronouncing that any given case of gonorrhœa is cured. The fact that no gonococci are found in the discharge at any one time is by no means a proof that the trouble has disappeared ; repeated examinations must be made. Indeed, so long as any discharge is present either from the urethra itself or from the prostate or the vesiculæ seminales—as shown by increase of discharge after pressure on these organs—no case should be looked on as cured.

GONOCOCCAL URETHRITIS IN THE MALE.

The inflammation commences in the anterior part of the urethra, the organisms attacking the superficial layers of the mucous membrane in the first place, but spreading more deeply later on. The inflammation rapidly spreads from the fossa navicularis along the penile urethra, to which it may remain limited for a few days ; it extends into the posterior urethra, however, in the majority of cases, and in no case does it remain limited to the anterior urethra after the second week of the disease.

The urethral mucous membrane becomes swollen, congested, and thrown into folds, and the inflammatory exudation spreads into the submucous coat, and may involve the spongy tissue surrounding the urethra, which then loses its elasticity and consequently does not stretch *pari passu* with the corpora cavernosa during erection. This condition leads to painful erections known as *chordee*.

The usual incubation period is from three to five days ; occasionally it may be as long as a week, and a much longer period has been noticed in very rare cases. The susceptibility of individuals differs greatly, and the disease is not necessarily always contracted when there has been exposure to contagion.

The acuteness of the inflammation usually increases for the first few days, and then remains more or less stationary for about ten days, after which it gradually subsides ; when the disease runs its course without complications and without passing into the chronic condition known as gleet, it will last about six weeks altogether. In a large number of cases the disease becomes chronic and may go on for an indefinite time; there being only a slight mucoid discharge ; the disease is then termed *gleet*.

Some of the *complications* met with are due to local extension of the disease, and some to infection of parts at a distance. Amongst the principal are balanitis, phimosis and paraphimosis, peri-urethral abscess; thrombosis; lymphangitis; bubo; epididymitis; prostatitis, vesiculitis, cystitis, retention of urine, gonorrhœal rheumatism, and gonorrhœal ophthalmia.

The first *symptom* complained of is irritation or itching about the meatus, the lips of which become stuck together by a glairy discharge. This is quickly followed by scalding pain on micturition and a profuse discharge of thick yellowish pus ; the lips of the meatus become intensely red and swollen, and painful nocturnal erections are often present. Micturition is unduly frequent, at first probably from reflex irritation rather than extension of the inflammation to the bladder. The acute symptoms subside in from ten days to three weeks, the discharge becoming thinner and more watery in character until it either disappears entirely or remains as a mucoid discharge known as gleet (see p. 358).

When posterior urethritis sets in acutely during the early stage, there is usually a diminution in the amount of discharge and a feeling of distension and burning in the perineum with markedly increased frequency of micturition ; there may be also a few drops of blood with the last drops of urine, caused by spasmodic contraction of the compressor urethræ upon the inflamed membranous urethra. Erections now occur frequently and may last for some time ; they are more or less painful according to the condition of the corpus spongiosum. If the urine is passed into two glasses, both portions will be cloudy and will contain shreds of mucus and pus ; this is most marked in the first portion.

During the chronic period, the discharge is most noticeable in the morning on separating the lips of the meatus and squeezing the urethra, when a drop of viscid or even purulent discharge will be expelled. In the intervals between micturition the discharge dries up over the meatus so that the lips stick together, and this is especially the case in the morning when a considerable time has elapsed since the last act of micturition.

TREATMENT.—This must be considered in reference to the various stages, and will be divided into : the treatment at the commencement of the attack ; during the acute stage ; during the stage of decline ; and the treatment of gleet.

Treatment at the commencement of the attack.—Here the question of *abortive treatment* presents itself, and many plans have been adopted with a varying amount of success. It is obvious that any attempt at true abortive treatment—that is to say, the destruction of the bacteria—must be carried out before they have had time to penetrate the mucous membrane ; once they are growing in the substance of the mucous membrane, no antiseptic will reach them. Attempts are sometimes made to abort the disease by injections of strong solutions of nitrate of silver (1 in 1000 to 1 in 500, or less) or of protargol. While these methods may sometimes succeed, they often fail, and the disease is then aggravated. We have given up the use of local antiseptics at this stage, but the early administration of copaiba often diminishes the severity of the subsequent inflammation.

Treatment during the acute stage.—The treatment must be

largely general; if local treatment is employed it must be unirritating, as its object is not to destroy the bacteria, for that is impossible, but to relieve the inflammatory symptoms; therefore it must never go beyond attempts to wash the pus out of the urethra. The patient should be kept quiet; it is even advisable for him to stay in bed for a few days, as complications are then less likely to occur. In any case; active exercise should be avoided, as well as anything that tends to sexual excitement. A suspensory bandage should be worn from the first, but the edge of the bag must not press upon the urethra; otherwise it might lead to retention of pus and increase of irritation. The bowels should be freely evacuated by means of salines, and the urine kept dilute and unirritating by mild diuretics, such as citrate of potash (gr. x to gr. xx, three or four times a day) or spirits of nitrous ether (℥xx) with an alkali, such as carbonate of potash (gr. xx); in addition, large quantities of diluent drinks, such as barley water, toast and water, or infusion of linseed; should be taken. In the very acute stage some sedative, such as tincture of hyoscyamus (℥x to ℥xx) or tincture of belladonna (℥v) may be added to the alkaline mixture. Alcohol must be entirely prohibited; it is remarkable how the inflammatory symptoms immediately increase if alcohol is taken. A light diet should be prescribed; and red meat, coffee and tea should be avoided.

The question of the administration of sandal-wood oil or balsam of copaiba during the early stages has been much discussed. It is probably better to avoid these drugs during the very acute stage, as they may upset the digestion, and it is even possible that they may render the urine more irritating. These drugs are of great value, however, as soon as the inflammatory symptoms are beginning to subside (see p. 352). Some surgeons strongly advocate the use of salol during the acute stage as having a direct antiseptic action upon the urethra, and they give it in 5- to 30-grain doses three or four times a day; urotropine in doses of 5 to 10 grains three times a day may also be given with the same object. If there is much scalding on micturition and the patient dreads the act, a good plan is to make him pass urine into hot water either by micturating while in a hip-bath or by immersing the penis in a vessel of hot water. Cystopurin—a double salt of sodium acetate and hexamethylenetetramine—has been well spoken of in this affection. It is given in doses of ten grains three times daily.

Chordee is best treated by the administration of bromide of potassium. This drug does not produce its effect for some hours after it has been administered, and it is therefore well to give it during the day as well as at bedtime. In any case a dose of 20 grains should be given about six o'clock in the evening and another about ten, and to the latter dose it is well to add tincture of belladonna (℥v to ℥xv). If this fails to prevent the erections, a half-grain suppository of morphine may be given at bedtime. Minor degrees of *chordee* are generally relieved by a hot sitz bath or even a cold douche; when it is very troublesome, leeches may

be applied to the perineum and the patient confined to bed, the foot of which is elevated.

It is very important to warn the patient as to the contagious nature of the discharges, and to urge scrupulous personal cleanliness. The hands should not only be thoroughly washed in water after handling the penis, but they should also be disinfected with 1 in 20 carbolic solution. Lint, wool, or dressings should be burned immediately they are removed, and care should be taken to prevent the discharges from coming into contact with the clothes or linen; a gonorrhœa bag should always be worn and should be changed frequently, the old one being burned directly it is removed. These bags may be bought ready made, and should consist of some medicated dressing; they should have a little salicylic wool placed at the bottom so as to absorb the discharge more readily, and they are best fastened to a band around the waist. From time to time the glans penis should be washed, the prepuce being fully retracted.

Local treatment.—Some advocate frequent irrigation of the urethra with warm normal salt solution during the very acute stage, whilst others inject various antiseptics. In our opinion it is better to leave the urethra wholly undisturbed during the few days of the very acute stage. The likelihood of antiseptics doing any good in the way of destroying bacteria is extremely slight at this period and they may cause much irritation. Even the possibility of effectually washing away the discharge by unirritating solutions is open to doubt, seeing that the mucous membrane is thrown into somewhat rigid folds during the acute stage and considerable pressure would be required to undo these folds. It is most undesirable at this period to dilate the urethra sufficiently to obliterate these folds, otherwise the discharge will almost certainly be carried down into the posterior urethra.

Treatment during the stage of decline.—From the practical point of view this is the most important stage, as during it the future of the case is probably decided, and if it is improperly handled, the condition may go on to the chronic form known as gleet, which is very troublesome to cure. It is during this stage that the more vigorous local treatment should be adopted.

The general treatment, with regard to hygiene and diet, should be the same as before; but during this period drugs—such as cubebs, copaiba, and sandal-wood—are of value; of these, sandal-wood oil is probably the most useful as it causes less gastric irritation than the others. It should be commenced in small doses and should be rapidly increased. During the first day one capsule containing five minims should be given three times a day, and on the following day the dose is doubled; on the third or fourth day the patient may take 15 to 20 minims, three times a day, if there are no symptoms of gastric disturbance. Salol (see p. 353) is also valuable at this period, and cystopurin and urotropine have been recommended.

The local treatment is of special value at this period, and takes the form of irrigation or of urethral injections, which may contain antiseptic or astringent substances, according as the object is to kill the bacteria or merely to diminish the congestion of the parts.

Urethral irrigation is preferred by many surgeons, and some advocate its use from the first. We are, however, of opinion, for the reasons already given, that it is better to employ the treatment described above for the initial stage of the disease and to commence irrigation when the acuteness of the attack has passed off, although the discharge may be still copious. The apparatus required consists of a douche-can, holding about a couple of pints and capable of being raised or lowered by a pulley

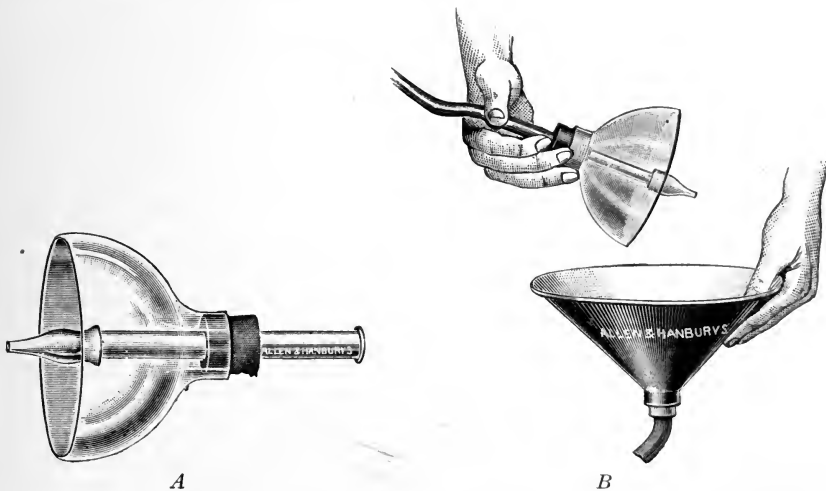


FIG. 94.—URETHRAL IRRIGATOR. *A* shows the detail of the irrigating tube, which can be protruded from or withdrawn into the glass shield fitting over the glans as may be desired. *B* shows the method of directing the fluid as it flows back into the glass shield into a drainage receptacle.

or any other convenient means. This is connected by a length of rubber tubing to the special end-piece shown in Fig. 94. This consists of a glass bell-shaped shield provided with an opening which is closed by a rubber cork, through which a glass tube passes, which may be furnished with a tap. The end of this tube is fitted to a conical nozzle so arranged that its tip just projects beyond the bell. The irrigator is filled with a dilute sterile solution of permanganate of potash (one grain to the pint). Before use, the apparatus should be sterilised by boiling. The tube is filled with the fluid, the end of the nozzle is passed into the external meatus, and the lotion is allowed to flow into and distend the urethra. If the douche-can is not raised more than two feet above the nozzle there is no risk of the solution passing back into the bladder. As soon as the urethra is fully distended, the flow from the douche-can is cut

off either by closing the tap or by compressing the tube between the fingers, and the nozzle is withdrawn sufficiently to allow the urethra to empty itself, the bell-glass serving to catch the fluid and direct it into a suitable receptacle placed between the patient's legs. The manœuvre is repeated over and over again until the lotion is used up. About a pint of the permanganate solution is employed at the first sitting; and this may be increased after three or four days to two pints. The strength of the solution can be increased up to five or six grains to the pint, but care must be taken not to make the solution so strong as to cause irritation. At first the irrigation should be performed night and morning, but after about a week, by which time the discharge should be appreciably diminished, once a day will suffice.

Urethral injections.—It is advisable always to begin with mild solutions in order to see whether they cause irritation. If this occurs, it implies that the treatment has been begun too soon, and the injections must be omitted for a time. In the first instance mild astringents, such as sulpho-carbolate of zinc (gr. i-ij ad ʒj), sulphate of zinc (gr. i-ij ad ʒj), chloride of zinc (gr. i-ij ad ʒj), protargol (0·25 per cent.), nitrate of silver (1 in 6000 to 1 in 3000), or permanganate of potash (1 in 4000) are the best.

In practising urethral injections it is important to prevent the fluid finding its way into the bladder, and also to insure that it comes into contact with all the folds of the urethral mucous membrane. The most convenient plan of carrying this out, when the discharge is scanty and it is essential to distend the urethra to some extent so as to get the injection fully into contact with all its folds, is to compress the urethra in the perineum close to the bulb, thereby preventing the injection finding its way farther along the urethra than this point. The contents of a glass syringe, holding only about a dram to a dram and a half, and having a bulbous nozzle that will entirely fill the external meatus, are gradually injected down the urethra until the mucous membrane of the latter is put fully upon the stretch. The syringe is now withdrawn, the lips of the meatus are pressed together so as to keep the fluid in the urethra for about two minutes, and then the fluid is allowed to run away; the process is repeated several times. The patient should always pass urine immediately before the injection is employed in order to wash away as much of the discharge as possible, and to avoid the necessity of having to micturate again for some considerable time; the effect of the local application is thereby prolonged. The greatest gentleness must always be used in making the injection so as to avoid any injury to the urethral mucous membrane. The syringe should be boiled each time before use, and the fluid should be used at the body temperature.

The test as to whether the patient is cured is the absence of urethral discharge and of shreds in the urine. It is not uncommon for patients

to find, after all discharge has ceased, that if they pass urine into a glass the first portion contains a number of thread-like filaments; these should be examined for gonococci, but, whether the latter are found or not, the presence of flakes implies that the disease is not cured. Of course if gonococci are found, the discharge must be looked upon as infective, and even the absence of these organisms must not be taken to imply a perfect cure except after repeated examinations extending over a prolonged period—three to six months. It is not uncommon to find that when a patient, who has ceased to have any discharge, leaves off the treatment, the discharge comes back two or three days afterwards, or he takes alcohol and gets a recurrence. In these cases the treatment must be resumed.

Of complications.—Most of the complications of gonorrhœa already referred to are described elsewhere.

Peri-urethral abscess is not an infrequent complication, and the abscess may burst into the urethra or through the skin or in both directions. A urinary fistula may usually be avoided if the abscess is opened externally directly its presence is detected. When it opens spontaneously both into the urethra and through the skin, a urinary fistula results; when it opens first into the urethra it may lead to extravasation of urine. This matter is dealt with more fully in Chap. XXXVI.

Inflammation of Cowper's glands is not uncommon in gonorrhœa and generally occurs about the third or fourth week of the disease. There is much pain and a feeling of tension in the perineum, the pain being aggravated on sitting or walking. On examination, a small ovoid tumour will be felt on either side of the middle line; it is said that the left gland is more frequently affected than the right. The swelling may gradually disappear under rest and the ordinary treatment for inflammation, but suppuration often takes place either in the gland itself or in the surrounding tissues. If an abscess occurs in the gland itself, the pus may find its way along the duct into the urethra and the duct becomes dilated; urine may then pass back into the cavity, leading to a urinary abscess and, later, urinary infiltration, or the abscess may rupture externally and a perineal urinary fistula may result. In other cases suppuration occurs outside the gland and the pus finds its way towards the perineum, when incision of the abscess will put an end to the trouble. Occasionally the inflammation becomes chronic and the glands remain large and hard for a considerable time.

The treatment should be that for acute inflammation in the early stages, with incision of the abscess if suppuration occurs, or excision of the gland should it be evident that suppuration is not occurring, seeing that resolution is not likely to take place for a long time.

GONOCOCCAL URETHRITIS IN THE FEMALE.

The usual affection in the female is inflammation of the cervix, the urethra being comparatively rarely affected. Zeissl states that in only about 5 per cent. of the cases is there any urethritis. It is more difficult to eradicate the disease in the female than in the male as it may remain latent in the cervix uteri for a long time. The inflammation has a tendency to spread to the body of the uterus and to the Fallopian tubes, giving rise to salpingitis; it may also extend to the peritoneum, and cause a pelvic peritonitis. The glands of Bartholin are frequently affected, and it is very difficult to get rid of the affection from this situation.

TREATMENT.—This is similar to that for the male, except that internal remedies have no value unless the urethra is affected. The value of copaiba and sandal-wood oil in the male is that they are excreted in the urine and apparently exert a local antiseptic action when the patient passes water, and consequently in the female these drugs are practically useless. In the acute stage the treatment takes the form of local applications, such as hip-baths and hot vaginal douches, whilst in the more chronic stages the various astringent injections already referred to (see p. 356), particularly nitrate of silver, may be used as vaginal douches. The local application of strong solutions of nitrate of silver to the cervix uteri may be called for.

GLEET.

While in favourable cases the discharge becomes steadily less purulent until it ceases in two or three weeks after the subsidence of the acute stage, it sometimes persists for a long time, and the condition is then called 'gleet.' The persistence of a gleet discharge is not uncommonly due to the localisation of the gonorrhoeal mischief in the deeper layers of the mucous membrane or submucous tissue in some very limited area; in most cases this area is situated either in the penile urethra from three and a half to four inches from the meatus—that is to say, at the junction of the penile and scrotal portion of the urethra—or about the junction of the prostatic with the membranous portion.

The local lesions met with at this stage are very various. The commonest is the so-called 'granular patch' which is seen through the urethroscope as a livid purplish area, somewhat raised from the surrounding mucous membrane, bleeding readily on being touched and closely resembling granulation tissue. Next in frequency to the granular patch, a condition of simple hyperæmia of a particular area of the urethral mucous membrane is met with. This is most common in the neighbourhood of the bulb; the vessels are dilated and unduly numerous, and the mucous membrane is bright red instead of being of its normal pink colour. Another, but less common, lesion is ulceration of the

urethra ; this is most often seen in the fossa navicularis, while sometimes it is met with as a small fissure about three inches down the penile portion. Evidences of inflammation may also be found about the orifices of Littre's glands. In the normal urethra these are barely visible depressions; in the subject of gleet, however, they may form livid areas the size of a pin's head, usually in groups. Occasionally they exude pus, or there may be a distinct swelling caused by the bulging of a distended gland. Another condition that careful urethroscopic examination, especially with the inflating apparatus (*vide infra*), may reveal, is the existence of sub-mucous induration, which shows itself as a series of rigid bands standing out in relief when the urethra is distended ; these bands are probably the forerunners of true stricture, although at the time that they are first discovered the actual narrowing of the urethra may be very slight.

In other cases the persistence of the discharge is due to the extension of the disease to the follicles of the prostate leading to hypersecretion, or to the vesiculæ seminales setting up a chronic vesiculitis which is a most obstinate condition. In the latter case, some semi-purulent material may be obtained in addition to the gleety discharge, if the vesiculæ are firmly pressed or massaged.

TREATMENT.—The treatment of this stage must be almost exclusively local ; when the disease has become really chronic, drugs have little or no effect upon it. Any article of diet or any form of exercise that is found definitely to increase the discharge must naturally be avoided, and also sexual intercourse or excitement. Alcohol should be taken very sparingly, if at all, and in any case champagne, beer, and heavy wines should be interdicted. Drugs by the mouth are of little value ; the patient commonly doses himself with sandal-oil, but this practically never influences the urethral discharge at all, while it may upset the digestion and make the patient very miserable.

Irrigation.—This is an extremely valuable method of treatment ; it is carried out in the manner described on p. 355. Like all methods of treating gleet, however, it is apt to fail, and in any case will probably have to be continued for a considerable time.

Urethroscopy.—Treatment of localised affected areas through the urethroscope is often of great value. With this instrument—a good form of which is shown in Fig. 95—the urethra can be examined minutely from end to end, and any diseased area can be directly illuminated, its surface cleaned and examined, and even the strongest drugs can be applied to it without risk to the surrounding healthy mucous membrane.

The urethroscope is used as follows : A tube of the largest size that the meatus will hold is disinfected by boiling, warmed, lubricated, and passed down into the membranous portion of the urethra ; very little useful information can be gained by inspection through too small a tube.

It is of the utmost importance to observe the most rigid asepsis with all the instruments; they should be boiled after use, and those parts which cannot be boiled—such as electric lamps—should be disinfected with formalin vapour, otherwise inoculation from one patient to another is very apt to occur. The patient is instructed to say if the point of the instrument passes over any particularly tender spot in its progress, as this is often an indication of the whereabouts of the affected area. The tube is passed in to its full length or as far as it will go.

When the tube is in position, the obturator is withdrawn, and the electric light is introduced and switched on. A cotton-wool mop is passed down the tube and made to cleanse the area of mucous membrane

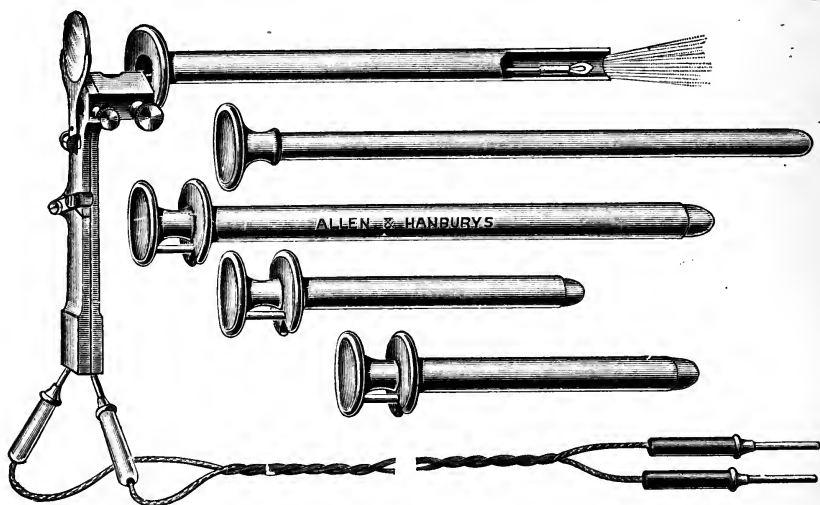


FIG. 95.—LUYS'S URETHROSCOPE. A powerful illumination is secured by mounting the electric lamp upon a long stem so that it lights the lower end of the tube direct. The tubes are made of different lengths for the anterior and posterior urethra. The obturators are solid.

exposed at the bottom of the tube. Special cheap wooden wool-holders that are burned after use are generally employed, but if these are not available, a simple plan is to roughen the end of a fine catheter stylet and roll the wool on that. The stylet is then bent at an angle of 120° about four inches from its handle, and forms a very useful urethroscope mop. Any area found to be affected receives its appropriate treatment (*vide infra*) as it is exposed.

An important point in the technique is always to carry out the examination of the urethra from behind forwards and not from before backwards, because, after the obturator has been taken out, the edge of the tube if pushed onwards, might excoriate the mucous membrane; hence the tube should be pushed backwards as far as desired before the obturator is withdrawn. Another important point is to make the application with

a mop which does not carry too much of the solution ; if too much is used it will come into contact with the surrounding healthy mucous membrane and may set up an unduly violent inflammation. We are in the habit of passing a larger dry mop down the tube immediately after the application has been made in order to absorb any excess. The greatest gentleness is necessary in the manipulations, as the slightest injury to the urethral mucous membrane will lead to bleeding, which obscures the view of the parts.

Local applications.—The best application for *granular patches* is a



FIG. 96.—POWELL'S INFLATING URETHROSCOPE. The proximal end of the tube is closed by a glass window which enables the urethra to be distended by means of the bellows. The light is reflected from the handle down the tube.

solution of nitrate of silver. When the mischief is comparatively extensive and scattered over the urethra, a mild solution should be employed, otherwise the reaction may be severe. A solution of five grains to the ounce will suffice in the first instance, and it will be found that the number of granular patches will steadily become less ; if necessary, stronger solutions (up to $\mathfrak{z}\text{j}$ or $\mathfrak{z}\text{ij}$ to the ounce) may be applied to the more resistant points. The applications should be made at intervals of about a week, and during the time that the patient is under treatment, the general measures for acute gonorrhœa (see p. 352) should be adopted, both as

regards drugs and also irrigation of the urethra, if there is much discharge after the application. The effect of the strong solution of nitrate of silver is to set up a fairly acute urethritis, which may even give rise to a blood-stained discharge for twenty-four hours or so; this, however, only lasts for two to four days. No other complication should occur if the application is carefully made, and the patient should always be told to expect an increase in the amount of discharge.

In the treatment of *intra-urethral ulcerations*, especially in the fossa navicularis, strong solutions of nitrate of silver (3j-ijj ad 3j of distilled water), or even the solid salt fused upon a probe, or equal parts of carbolic acid and glycerine should be used. Special care must be taken not to allow the application to come in contact with the healthy mucous membrane; the surface must be dried after the application has been made, and a good plan is to fill up the urethroscope tube with saline solution so as to dilute and wash away any surplus salt. A little aseptic

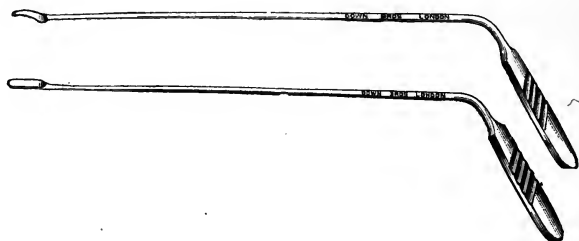


FIG. 97.—URETHRAL KNIVES. These are introduced through the urethroscopic tube; the lower one is for dividing indurations, the upper for slitting up Littre's glands.

wool is applied over the meatus, the prepuce is drawn forwards, and the penis is inserted into a gonorrhœa bag.

Indurations of the submucous tissue may be treated in one of two ways. The minor varieties can be easily detected by an inflation apparatus—such as is shown in Fig. 96—and are satisfactorily overcome by the passage of full-sized Lister's bougies or an Otis's urethral dilator. The occasional success which followed the old plan of passing bougies as a routine treatment for gleet probably occurred in these particular cases. Marked indurations are best divided by suitable urethral knives (see Fig. 97) introduced through the urethroscopic tube and made to nick the constriction. A few drops of a 4 per cent. solution of novocaine with a little adrenalin chloride are injected down the urethroscope tube, and after five minutes the excess of fluid is mopped up, the knife is introduced down to the constriction, and the latter divided by cutting downwards towards the floor of the urethra. This can be done without pain and in a few seconds, and more than one constriction may be divided if present.

Persistent inflammation or suppuration in Littre's glands calls for similar treatment. If any spot fails to heal after the application of a

strong solution of nitrate of silver (3ij ad 3j), it usually suffices to touch it with solid nitrate of silver fused upon a probe. When there is actual suppuration or when discharge is seen issuing from the orifice of the gland, the surface should be anæsthetised (*vide supra*) and the orifice of the follicle slit up with a special sickle-shaped knife (see Fig. 97).

The treatment of inflammation of the prostatic urethra or of the vesiculæ seminales is best effected by massage of the prostate or the vesiculæ through the rectum. At the same time irrigation and the general treatment recommended for gleet should be employed.

Vaccines.—Gonococcus vaccine has been widely used for these cases, but it must be confessed that the results have been distinctly disappointing. It should be an autogenous preparation.

NON-VENEREAL URETHRITIS.

This condition has already been referred to in connection with the causes that give rise to urethritis, and only requires mention here. It may be caused by the application of various irritants to the urethral mucous membrane, or by foreign bodies, urethral calculi, or catheters, while occasionally it is met with in gouty subjects.

TREATMENT.—This resolves itself into the removal of the irritating cause, when the affection usually subsides readily. Urinary antiseptics, such as salol (gr. x, t.d.s.) or urotropine (gr. v–xv, t.d.s.) may be useful. If the patient is gouty his gout should be treated.

CHAPTER XXXVI.

STRICTURE OF THE URETHRA.

UNDER this term are included all obstructions to micturition due to alterations in the wall of the urethra. Three forms may be distinguished, namely: **spasmodic stricture**, in which the obstruction is due to spasm of the muscles surrounding the membranous urethra; **congestive stricture**, in which the difficulty is due to inflammatory swelling of the mucous membrane, generally of gonorrhœal origin—when this condition causes complete retention of urine it is associated with spasm of the membranous urethra; **organic stricture**, which is the most important form, and will be described first.

ORGANIC STRICTURE.

In this condition there is an actual organic change in the urethral wall, which leads to narrowing or rigidity of the canal.

Organic stricture may be of two varieties. (1) It may be *traumatic* following bruising or rupture of the urethra; in this case the stricture is due to contraction of the cicatrix formed during repair of the injury. When the urethra is torn across, an annular stricture forms; when the tear is only partial, ridges and less complete strictures occur. This form of stricture is most common in the membranous urethra (see Chap. XXXIII.).

(2) The great majority of organic strictures are *inflammatory* in origin, and are due either to repeated attacks of gonorrhœa or to long-continued gleet in which the inflammation does not remain limited to the surface of the mucous membrane but involves the submucous coat and even the spongy tissue. This form of stricture occurs chiefly in the spongy urethra, most commonly at, or close to, the bulb, and may spread back and involve the commencement of the membranous portion, although this is comparatively rare. Organic stricture also frequently occurs near the urethral orifice, while another common situation is in front of the scrotum at the point of flexure of the penis. The stricture

may be single or multiple. In very bad cases a considerable length of the urethra may be affected, the tightness of the obstruction varying at different places and giving the impression of a number of independent strictures; as a rule the canal between these multiple strictures is also contracted.

The prostatic urethra is never the seat of either a spasmodic or an organic stricture. When spasm occurs in its neighbourhood, it is in the neck of the bladder itself and not in the urethral canal.

When it occurs in the bulbous urethra the stricture is usually extensive and consists of dense newly formed fibrous tissue, and is sometimes spoken of as a *callous stricture*. The chief formation of fibrous tissue occurs in the floor of the urethra, and the urethral canal is displaced upwards, the roof being scarcely if at all affected; sometimes, however, the thickening is lateral, and the urethral canal is diverted to one side.

Sometimes the material forming the stricture is extremely elastic, and to this form the term *resilient stricture* is applied. These strictures are usually quite narrow and are most frequently met with in the penile portion. They are important from the point of view of treatment as, although they dilate easily, they do not undergo absorption as does the callous form.

A third form is sometimes termed a *bridle stricture*. In this the inflammation is practically limited to the floor of the canal and the mucous membrane becomes raised as a sort of valve or band across the lumen; these strictures occur in the anterior part of the urethra.

Organic stricture of the urethra is a most serious condition, as the interference with the outflow of urine causes marked changes in the whole of the urinary tract behind it. The urethra becomes dilated immediately behind the obstruction, and in bad cases a large pouch may be formed. In this situation, too, the urethra becomes thinned and inflamed and may be ulcerated, so that rupture may occur when the patient micturates; this complication leads to extravasation of urine. Short of rupture, the inflammation may extend into the peri-urethral tissues and give rise to an abscess communicating with the urethra, into which urine will be forced every time the patient passes water. In this way a urinary abscess is formed, and extravasation of urine may occur if the wall of the abscess gives way, or the abscess may open in the perineum and a perineal urinary fistula may be established.

Changes also occur in the bladder owing to the difficulty in evacuating its contents. In the early stages there is hypertrophy and diminution in capacity, whilst in later stages the organ becomes atrophied and dilated. Cystitis is a common complication and may be very severe; it may occur independently of the use of instruments, but the latter are frequently the vehicles for the introduction of the organisms, and all the conditions most favourable to the spread of septic inflammation are met with behind the stricture.

The back-pressure also leads to dilatation of the ureters and the renal pelvis, and sepsis is very common when the case is of long standing, with the result that pyelitis and suppurative pyelonephritis occur. Death may take place from cystitis, extravasation of urine, pyelitis, or the so-called surgical kidney.

Symptoms.—There is steadily increasing difficulty in micturition; the act takes abnormally long and is often unduly frequent and the patient feels that he does not empty the bladder completely. Urine is apt to collect in the dilated urethra behind the stricture and to trickle through after the act of micturition is complete, so that the clothes are constantly wet and have a strong urinous odour. The forked and twisted stream usually described is not characteristic of stricture, but when it is met with it is usually due to a stricture near the meatus; when the stricture is situated far back, the urethra in front of the stricture becomes uniformly filled with urine and the stream, though smaller in calibre and less forcible than it should be, is not necessarily forked. When the stricture is tight, there is frequently purulent urethritis or a gleet discharge, particularly in gouty or rheumatic subjects.

The diagnosis is made by examining the urethra with instruments; this is also the first step in the treatment.

TREATMENT.—This varies in different circumstances. We may divide the cases met with in practice into two great groups, namely: uncomplicated strictures and strictures accompanied by complications. The latter class must be considered according to the various complications present, and we shall divide them into strictures complicated (a) with false passages; (b) with cystitis; (c) with epididymitis; (d) with retention of urine; (e) with peri-urethral abscess; (f) with perineal fistula; (g) with extravasation of urine.

Treatment of uncomplicated strictures.—These strictures are often divided into two groups, which are termed 'permeable' and 'impermeable,' according as the surgeon is able to pass an instrument through them or not. Obviously there is no such thing as a complete occlusion of the lumen in uncomplicated cases, because there must be a channel as long as the patient can pass urine. The urethra may be temporarily occluded, however, and, even if not, it may happen—although rarely in skilled hands—that the surgeon is unable, even after many attempts, to pass an instrument through the stricture; as a rule he will succeed, with patience and care, in the great majority of cases. The only strictures which may be impermeable in the strict sense of the word are those in which perineal fistulæ are present and in which urine has not passed through the urethra for a considerable time owing to the greater freedom with which it escapes through the fistulæ. The surgeon should always approach a case of uncomplicated stricture with the idea that it is possible to pass an instrument through it.

The treatment of simple uncomplicated organic stricture varies

according to the character of the obstruction, and different methods are required for resilient, bridle, and callous strictures; it may also be modified according to the number and situation of the strictures. The methods for dealing with simple uncomplicated strictures are: (1) intermittent dilatation; (2) continuous dilatation; (3) internal urethrotomy;

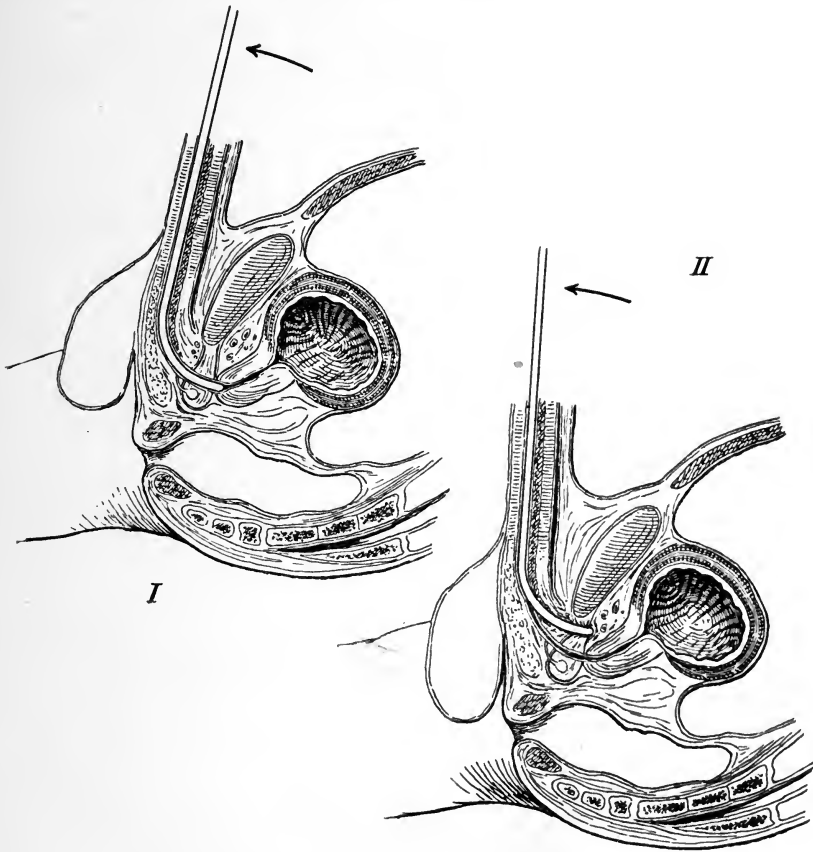


FIG. 98—DIAGRAM TO ILLUSTRATE THE MODE OF FORMATION OF A FALSE PASSAGE. *I*, shows the end of the bougie safely in the prostatic urethra before the handle is depressed. *II*, shows how the point of the instrument pierces the roof of the urethra if the handle is depressed before the point has passed through the membranous portion.

and (4) external urethrotomy. The use of caustics or forcible dilatation is not to be recommended; destruction of the stricture by electrolysis is seldom practised now and need not be considered. We shall describe the various methods of dilating the strictures first, as this is the plan most commonly employed; even when urethrotomy is to be performed, some dilatation of the stricture must as a rule precede the operation.

In examining a case for stricture by means of a bougie it is not unusual to mistake spasm of the urethra for an organic stricture, and this is

most likely to happen if the surgeon commences the examination with too small an instrument. It may be taken as an axiom that any instrument that will pass through the meatus should pass without difficulty through the rest of a normal urethra; in order therefore to ascertain whether a stricture is present, the first instrument used for exploration should be one as large as the meatus will admit. If the surgeon accepts the patient's statement that he has a stricture and commences with a small-sized instrument, he may be easily misled into thinking that a stricture is present when none exists, as the point of a fine bougie is

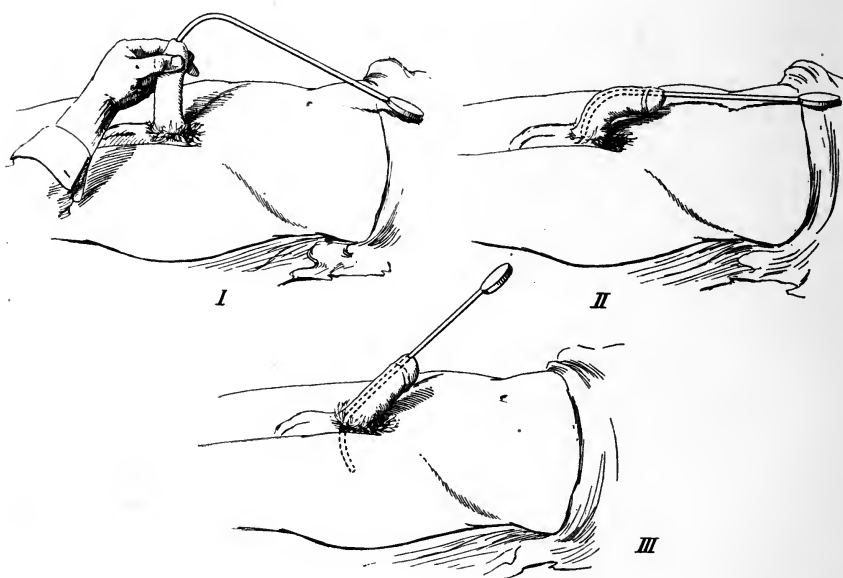


FIG. 99.—THE USUAL METHOD OF PASSING A URETHRAL BOUGIE. The instrument is kept in the vertical median plane of the body throughout.

apt to catch in the folds of the mucous membrane, and this not only impedes the passage of the instrument but may set up spasm, which will interfere still further with the examination. Moreover, with a small instrument, a stricture may be overlooked; as all strictures are not necessarily very narrow, and a stricture that will not admit a No. 6 may allow a No. 3 to pass without hindrance. Another point of importance is that the instrument should be rigid as well as full-sized. A flexible instrument cannot be guided well. A No. 12 English metal bougie is generally employed in adults for diagnostic purposes.

The patient should lie on his back, and all the aseptic precautions referred to on p. 374 are taken; the surgeon stands on the patient's left side, grasps the penis just behind the glans and puts it on the stretch. In attempting to pass instruments, the direction and length of the various

portions of the urethra should be borne in mind. Thus, if the organ is held vertical, the bougie must first pass directly downwards for about six inches, until it reaches the commencement of the membranous urethra; this portion runs almost horizontally for about three-quarters of an inch, and then the prostatic urethra curves forwards and upwards for about an inch and a quarter before the bladder is reached. The mistake usually made is that the point of the instrument is not passed far enough down into the bulbous urethra, and the handle is prematurely depressed, so that its point is thrown up against the urethral roof just in front of the entrance to the membranous urethra, and if force is used may perforate the wall at that part and thus make a 'false passage' (see Fig. 98).

There are three ways in which a catheter may be passed. (a) In the first plan (see Fig. 99) the instrument is held parallel to the long axis

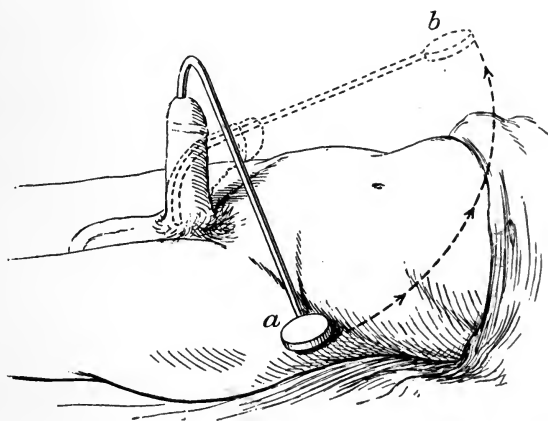


FIG. 100.—THE 'DEMI-TOUR DE MAÎTRE.' The dotted line shows the passage of the head of the bougie from the position, *a* to *b*; when it reaches *b*, it is raised to the vertical, as in the previous figure.

of the body, its handle lying almost flat on the abdominal wall. The penis is held erect, the tip of the instrument is passed down the urethra until the bulb is reached, and then the handle is gradually raised to the vertical so as to engage the point of the instrument well in the membranous urethra. The handle is finally depressed between the thighs, and the point is made to pass upwards and forwards through the prostatic urethra into the bladder.

(b) Another plan (see Fig. 100) is to hold the instrument horizontally at right angles to the long axis of the body, and pass the point down the urethra until it reaches the bulb. The handle is then rotated through a quarter of a circle until the shaft lies in the middle line, the handle being also slightly raised at the same time so that it does not actually touch the abdomen. This latter manœuvre is important; without it the point of the instrument is apt to be somewhat withdrawn during the rotation,

and does not enter the membranous urethra. All that now remains is to raise the handle to the vertical, and then to depress it between the thighs so as to pass the prostatic urethra. This is the so-called 'demi-tour de maître.'

(c) The third method, which is sometimes of value in attempting to pass an instrument through a narrow stricture, is the so-called complete 'tour de maître' (see Fig. 101). In it the instrument is passed, as in *b*; until the point is as far down the bulb as it will go. Instead of rotating the instrument up to the middle line it is now rotated downwards between the thighs, then across the opposite thigh, and then from that point to

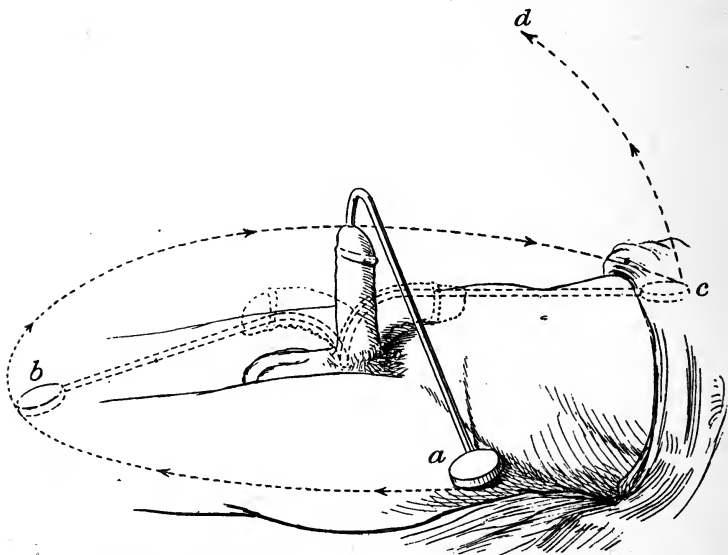


FIG. 101.—THE 'TOUR DE MAÎTRE.' The arrows denote the course taken by the handle of the instrument from *a* to *d*.

the middle line. During the whole manœuvre care is taken to keep the point well pressed down in contact with the stricture. This plan has the advantage that it brings the point of the instrument into contact with various portions of the stricture in succession, and therefore it may at some point slip through the opening in it.

If no stricture exists, a No. 12 English bougie will pass easily into the bladder—at any rate, after a little steady pressure—when introduced by either of the first two methods mentioned, provided always that it will pass through the external meatus, and that no attempt is made to push it on towards the bladder before the point is properly engaged in the membranous urethra. If on the other hand a stricture is present, the instrument will be arrested at that point. The surgeon must then determine whether the obstruction is due to an organic stricture or

whether the instrument is merely arrested by spasm ; the latter usually occurs at the entrance of the membranous urethra. Before concluding that an organic stricture is present and withdrawing the instrument in order to try a smaller one, gentle pressure should be kept up against the obstruction for a short time to see whether the instrument will not pass into the bladder ; as a rule the spasm gives way suddenly. If in spite of this, the instrument will not pass through the triangular ligament, an organic stricture in the bulbous or bulbo-membranous portion may be diagnosed. Obstruction to the passage of an instrument in the prostatic urethra is due either to enlargement of the prostate or spasm of the sphincter vesicæ.

After the existence of an organic stricture has been diagnosed, its distance from the meatus should be measured off on the bougie for future reference. The examination does not, however, cease here, as it is necessary to ascertain the length and tightness of the stricture and whether more than one is present. Hence smaller instruments must now be employed, both for examination and also for treatment.

When the surgeon has failed to pass a full-sized instrument (No. 12) the next size chosen should be a No. 9-12 Lister's graduated metal bougie



FIG. 102.—ACORN-TIPPED URETHRAL BOUGIE.

(see Fig. 103) ; should that fail, a No. 7-10 should be tried, and so on downwards, substituting the soft black olivary or acorn-tipped bougies (see Fig. 102) for the metal instrument below a No. 6.

It is important *to ascertain the length* of the stricture, especially when an internal urethrotomy is likely to be required, and this may be done by using bulbous-ended instruments or, better still, the acorn-tipped bougies (see Fig. 102), which not only meet with resistance when they enter the stricture but, owing to the shape of the shoulder, also meet with resistance when an attempt is made to withdraw them through the stricture. In this way the distance both of the anterior and the posterior edge of the stricture down the urethra—and therefore its length—may be ascertained.

It is also important to decide *whether more than one stricture is present*. This is easy if the stricture that is situated nearest the bladder is tighter than those below it ; if the largest instrument that the distal stricture will admit is passed, it will then become arrested by the tighter stricture farther down. If, on the other hand, the distal stricture is the tighter of the two, the proximal one will probably escape recognition until the distal stricture has been dilated beyond the number that the proximal one will admit. A final point of some importance about which information may be obtained is the *dilatability* of the stricture. By using graduated bougies, as recommended below, the resistance of the stricture

to the dilating force may be gauged to some extent and an idea may be gained as to whether the stricture is readily amenable to dilatation or not.

There is considerable difference of opinion as to whether a rigid or a flexible instrument should be used when the smaller numbers (from No. 6 downwards) are required. The advocates of metal instruments argue that with them the surgeon is able to work with greater precision, as he can guide the point in the direction in which he desires it to go, whereas a small flexible instrument is apt to curl up in the urethra and does not take the direction that the hand desires to impart to it. On the other hand those who advocate flexible instruments hold that it is difficult to direct the point of a fine instrument intelligently among the numerous folds met with in the urethra, and further that it is often impossible, even in the most skilled hands, to avoid doing damage to a sensitive urethra. However this may be, it would seem that the wisest plan for those who are not specially skilled in passing bougies is to refrain from using metal instruments of a smaller calibre than No. 5 English, except under special

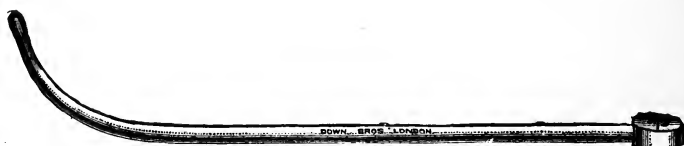


FIG. 103.—LISTER'S GRADUATED METAL BOUGIE.

circumstances. With the fine flexible instruments they can at least do no harm, and repeated attempts will generally counterbalance early failures.

On the other hand, there is a distinct advantage in using metal instruments of such a size that their points are not likely to become entangled in the folds of the mucous membrane and are not likely to penetrate the urethra if they do. Metal bougies from No. 6 upwards can be more easily guided and are under better control, while at the same time the resistance imparted to them by a stricture is more easily detected than with a soft instrument. These remarks apply to the passage of instruments whether for investigation or for dilatation.

Dilatation.—The object of this method of treatment is to place the patient in a position in which recurrence of the stricture may be prevented with a little care. Dilatation, moreover, is a necessary preliminary to other methods of treatment, such as most forms of urethrotomy, and it is therefore important for the surgeon to be an adept at it.

The instruments used for dilatation may be either rigid or flexible; we have already given indications with regard to the choice of these (*vide supra*). The best metal bougies are Lister's (see Fig. 103), which

are conical instruments increasing three sizes from the tip to the shaft. The tip is bulbous so that, when the point has passed through the stricture, the narrow neck lies loose in the latter and the surgeon can therefore gently manipulate the conical portion through the stricture, and thus dilate it. Of the soft instruments the best are the black olivary bougies (see Fig. 104) which are similar in principle. The solid instruments have the ordinary urethral curve, but, if the stricture is situated in the penile urethra in front of the bulb, it is often easier to use straight instruments graduated in the same manner. By holding the penis vertical and putting the urethra fully on the stretch, straight instruments are more easily manipulated through the stricture than curved ones. No attempt, however, must be made to pass a straight metal instrument farther than the bulb.

Intermittent dilatation.—Before describing the steps of this method of treatment, there are a few points in connection with it which deserve special mention, and the first is that in a case of multiple strictures no attempt should be made to deal with the deeper strictures until the first has been dilated sufficiently freely to enable the instrument that is to be used for the dilatation of the deeper ones to be passed freely through it. If the anterior stricture grasps the bougie firmly, the surgeon has no control over the point, and attempts to pass it on through a deeper stricture are very likely to end in making a false passage. This is a most important matter in these particular cases because, whereas a false passage is only serious as a rule in so far as it renders it difficult to pass an instrument through the stricture, a false passage between two strictures may give rise to considerable risks. Urine rarely finds its way down a false passage that has been made in front of a stricture, as the false passage runs in the same direction as the urethra, and the urine, after passing through the stricture, finds its way out of the urethra more readily than along the false passage and thus there is no risk of urinary infiltration. If, however, the false passage is situated between two strictures and the stricture in front has not been fully dilated, it causes obstruction to the flow of urine and the latter may therefore find its way along the false passage and lead to urinary infiltration.

Another point in dilating a stricture, particularly by the intermittent method, is not to do too much at one time. Opinions vary much as to the degree to which dilatation should be carried at one sitting, some surgeons holding that it may be carried to a full size, whilst others stop

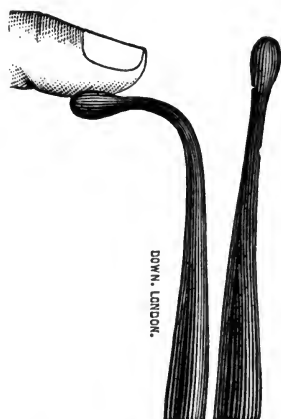


FIG. 104.—FLEXIBLE 'BOUGIES À BOULE.'

at some arbitrary number, say, No. 7. No hard and fast rule, however, should be applied to these cases, and the surgeon must be guided by circumstances. He should always err if possible on the side of going too slowly. If the stricture is tight and instruments are passed with difficulty, a certain amount of splitting will result if the dilatation is effected too rapidly, and much inflammation and swelling may follow, accompanied by risks of septic absorption. Attempts to dilate the stricture up to No. 12 or 14 at the first sitting are likely to end in a considerable amount of damage. The cure of a stricture by dilatation is, however, not a purely mechanical one ; in some way that is not clearly understood, the passage of an instrument through a stricture leads to absorption of the inflammatory products, and this plays a far more important part in the cure than the mere stretching occasioned by its introduction. If the stricture is so rapidly stretched that it is actually torn, there is a risk of inflammation occurring, and this will be followed by the formation of new fibrous tissue, which contracts, and so defeats the object of the dilatation. If the stricture is very tight, the best plan is to try a second, after passing one instrument, and, if that passes, to be content, for the stricture will then be dilated four sizes. In strictures however that are easily dilatable, the process may be safely carried beyond this point, and three or four instruments may be passed in succession. If the attempt to pass the second instrument does not succeed at once, it is better to desist rather than to irritate the urethra by prolonged attempts, and the surgeon may be satisfied on the first occasion with having succeeded in passing the stricture ; on the second there will not be the same difficulty.

Disinfection of catheters.—When catheters are employed, the greatest care must be taken to avoid infection of the bladder, and the first question is the disinfection of the instrument. In the case of metal or red-rubber catheters this is readily done by boiling ; the patient may carry his rubber catheter about with him in a large test-tube provided with a metal case. Before use, the tube is filled with water above the level of the catheter, and is boiled for at least five minutes. After use, the catheter is thoroughly rinsed in warm water and placed in the test-tube again.

The effectual disinfection of black and gum-elastic catheters is a matter of difficulty. They are ruined both by boiling and by strong antiseptics, and, although 1 in 1000 sublimate may be syringed through them and the catheter immersed in the solution for a short time, they must not be kept in it for any length of time, and they seldom last long even then. A flexible catheter that can be boiled repeatedly without deterioration is made by Porgès of Paris (see p. 413). A usual plan is to syringe the catheter after use with warm water, and place it in a long tube containing a solution of 1 in 1000 perchloride of mercury in glycerine until required again, when the sublimate is rinsed away with hot water. Formalin

is now largely employed for the disinfection of catheters, and a convenient plan is to expose the catheter to the action of tri-oxy-methylene. Formalin is a 40 per cent. solution of formic aldehyde in water, and is used in strengths of 2 to 10 per cent. in water. When tri-oxy-methylene is used, the drug is dusted over the bottom of an air-tight box or glass jar, and the catheters are laid upon shelves or trays of gauze or perforated metal; formic aldehyde is given off slowly when the drug is exposed to the air, and has a powerful germicidal action. The lid of the receptacle must be air-tight.

The precautions necessary to avoid infection do not stop at the cleansing of the catheter, as a perfectly aseptic instrument may nevertheless introduce organisms into the bladder from the lubricant employed or from the urethra or skin of the penis, or the hands of the operator.

The usual lubricant has for its base either some oily substance or glycerine. Of these, glycerine may be used either as pure glycerine or boro-glyceride, both of which are aseptic. The objection to glycerine is that it is an imperfect lubricant. Sterilised oil may be poured from a bottle over the catheter, so that there is no necessity for touching the latter with the finger; under no circumstances should the instrument be introduced either into an oil-bottle or an ointment-jar. Capsules, containing sufficient sterilised oil for one instrument, can now be obtained and are very convenient, as they ensure that the lubricant is only used once.

The surgeon's or the patient's hands must be disinfected before passing the catheter, and the glans and the orifice of the urethra must also be cleansed. The patient should always be strictly enjoined to wash the hands and disinfect them with carbolic solution, and the glans penis should also be washed, and the meatus mopped out with a twist of cotton-wool dipped in 1 in 2000 sublimate solution. The strictest precautions with regard to the fingers must be enforced in the case of patients who pass soft rubber catheters for themselves. In passing these instruments they have to be seized first close to the eye, and the fingers must then be shifted farther and farther along the instrument as it passes down the urethra, and therefore it may be infected by dirty fingers throughout its length.

A patient who has to pass catheters for himself should therefore be provided with an outfit, consisting of a Jaques' catheter in a test-tube, a spirit-lamp, a bottle of carbolic acid for the fingers, and another of sterilised oil (or with sterilised oil in capsules) for the instrument. These can be packed in a case, which the patient should always carry with him.

All instruments should be warmed and oiled, and in tight strictures it is a good plan to inject some sterilised oil into the urethra, so that there may be sufficient lubricant in the neighbourhood of the stricture; if the instrument is lubricated in the ordinary way, the urethral mucous membrane may have rubbed off the lubricant by the time the stricture is reached.

The patient should be kept in bed for a day or two before the first instrumentation is carried out, if possible. A general anæsthetic is unnecessary, except under special circumstances. Should the urethra be irritable or the patient nervous, local anæsthesia (20 drops of a 4 per cent. solution of novocaine injected down the urethra) will help considerably. Should the urethra be congested, the addition of adrenalin chloride (1 in 1000) to the above will still further help by diminishing the vascularity of the parts.

In the subsequent process of dilating a stricture, the surgeon begins with the largest-sized instrument that previous examination has shown him that the stricture will admit, passing it in the manner described on p. 368.

When a metal instrument is used, the chief error likely to be made in deep-seated strictures is to think that the opening in the triangular ligament has been reached before it really has. The handle of the instrument is thus raised prematurely and its point is forced through the roof of the canal running thence down alongside the urethra, behind which it passes until it lies between the prostate and the rectum (see Fig. 98). Hence, when the point of the instrument has arrived at the stricture, the greatest gentleness must be employed, and the surgeon should try to find the passage through it by using the instrument as a probe; the handle should be lightly grasped between the thumb and forefinger, and no pressure should be exerted while the position of the tip of the instrument is altered in the attempt to find the way through the stricture. If this fails, the 'tour de maître' (see p. 370) will often succeed if a metal instrument is being used. No attempt should be made to force the instrument onwards until it is definitely engaged in the stricture. The grip of the stricture is quite characteristic, and when felt it is allowable to force the instrument gently onwards; even here, however, no great amount of force should be used.

In difficult cases the left forefinger may be introduced into the rectum and pressure made by it at the junction of the membranous with the prostatic urethra as the handle of the instrument is raised. The finger in the rectum will also help the surgeon to make sure that the instrument has not gone into a false passage. When a false passage has been made, the point of the instrument lies between the prostate and the rectum, and is felt clearly by the finger in the rectum; if, however, the bougie is lying in the urethra, the substance of the prostate intervenes between the finger and the instrument.

When small flexible instruments are employed, the black olivary bougies (see Fig. 104) are generally chosen; catgut or whalebone instruments may be used for the very tight strictures. Much patience must be exercised, as there is little power of guiding the tip of the instrument. These fine instruments are easily passed down to the stricture; if the point catches in the mucous membrane, the bougie is withdrawn for a

quarter of an inch or so and then passed onwards, the penis being kept fully on the stretch. When the face of the stricture is reached, attempts are made to find the opening and insinuate the point of the bougie through it; this is best done by withdrawing the instrument slightly and then pushing it on in different directions. When the point becomes engaged in the stricture the bougie, if a flexible one, can often be passed through it if a slight rotary movement is imparted to it so as to screw it through the stricture.

In the treatment of tight strictures the so-called 'urethral whips' (see Fig. 105) may sometimes be used with success. These are long soft instruments tapering from a very fine point to a stout stem, the difference between the two ends being as much as eight or nine sizes. When the point of one of these instruments has passed through the stricture, the rest of it is pushed on until the stricture is well dilated, the fine flexible end curling up in the bladder. These instruments have the advantage that most of the dilatation is done at a single sitting. They have the disadvantage, however, that they are not so easy to manipulate as the smaller forms; their length makes them somewhat unwieldy, and they cannot be twisted through a tight stricture in the same way.

After the first sitting, the patient should be kept in bed for twenty-four hours at least, and an interval of three days allowed to elapse before a second is undertaken. At this sitting an instrument of the same size as was originally passed on the first occasion should be used first, and two or three more instruments may be passed in succession. Three days are again allowed to elapse, and the third sitting commences with a size larger than that passed first at the second sitting and is carried a little farther. By proceeding in this gradual manner a 9-12 can be passed in two or three weeks, and, as a rule, it is well not to go beyond this for one or two sittings. Over-dilatation may be practised with advantage, however, if it is found that dilatation is proceeding readily, and the stricture may ultimately be dilated up to a No. 15 English. When this stage

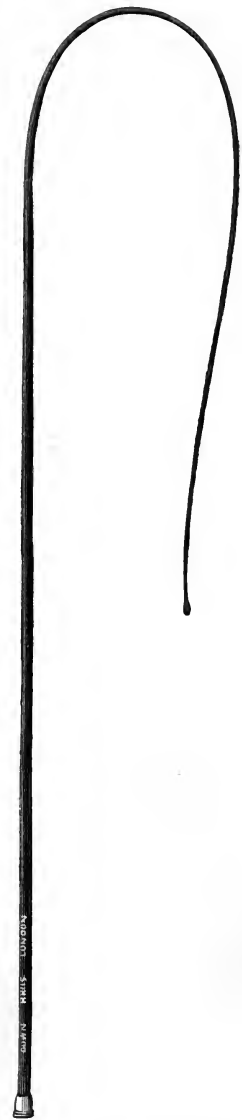


FIG. 105.—* URETHRAL WHIP BOUGIE.

has been reached, the interval between the passage of the instruments may be increased. In the first place the interval may be four or five days; then a week may be allowed to elapse; then ten days, and then a fortnight. After that, an instrument should be passed once every two or three weeks for several weeks, when the interval may be increased to a month or two, or even three. It is well, however, not to allow the patient to abandon instrumentation entirely, otherwise recurrence is apt to take place as time goes on. The surgeon should pass an instrument at least once or twice a year, both because it is advisable that he should see whether there is recurrence and also because he can do it better than the patient himself. If, however, the patient is so situated that he cannot have instruments passed by a surgeon, he should use a soft black tapering bougie, the tip of which measures No. 9 and the shaft 12 or 13; this can be got through the stricture quite easily and without any risk of damage if it is well oiled and warmed. He should pass an instrument of this kind every three months, keeping it in position for ten or fifteen minutes, and the procedure should be repeated oftener if there is any difficulty. He should never be taught to pass metal instruments, otherwise he is very likely to do damage. When a patient passes instruments for himself, the greatest stress must be laid upon the necessity for using absolutely sound instruments. Any instrument that shows cracks or any imperfection should be destroyed at once and a sound one substituted. Patients are very apt to use rough and cracked instruments, which easily damage the mucous membrane. They must also be specially instructed as to the antiseptic precautions.

Continuous dilatation.—This method is not to be recommended save under exceptional circumstances. When, for instance, a catheter has been introduced into the bladder with difficulty through a tight stricture in a patient suffering from retention, tying in the instrument insures evacuation of the bladder, while at the same time it leads to absorption of the stricture, and subsequent instrumentation will be facilitated. Again, in a stricture which is too rigid to yield to intermittent dilatation, continuous dilatation may be tried before resorting to a cutting operation. It should never be employed, however, when there is grave cystitis or renal disease; in these cases dilatation of any kind should be avoided. The objections to the continuous method are chiefly those due to the presence of an instrument in the urethra; this is apt to give rise to urethritis, which may spread into the bladder and be followed by cystitis.

In continuous dilatation a catheter is introduced through the stricture, tied in position, and left for twenty-four hours. The instrument should lie comparatively loosely in the stricture, and there is no need to pass the largest size that the stricture will admit. At the end of twenty-four or forty-eight hours, some dilatation of the stricture will have taken place, and an instrument one or two sizes larger can then be easily introduced

and tied in. A stricture may be fully dilated in this way in the course of a few days. The patient must be confined to bed and should take some urinary antiseptic (see p. 354) internally ; if there is trouble from erections, bromide of potassium and chloral may be given once or twice daily, combined if necessary with a suppository containing a quarter of a grain of extract of belladonna and a grain of extract of hyoscyamus.

Accidents attending the passage of an instrument.—Several embarrassing and even serious accidents may accompany the passage of an instrument. Occasionally there is much *shock*, and the patient faints and remains collapsed for a time. This is especially the case with neurotic subjects, and may occur even when the greatest gentleness is employed. When the patient is known to be very neurotic it is well to administer a small dose of morphine previously or to apply novocaine to the urethral mucous membrane ; 20 minims of a 4 per cent. solution of novocaine are taken up in a Guyon's syringe, the nozzle is introduced about an inch down the urethra, and a few drops are pressed out ; the nozzle is then passed farther on and more injected, and so on, until the drug has been brought into contact with the whole of the urethra down to the stricture. The lips of the meatus are pressed together so as to prevent the fluid escaping, and in ten minutes the mucous membrane will be fairly insensitive. The administration of brandy or a diffusible stimulant, such as sal volatile, is called for if shock occurs, and the patient should stop in bed for the rest of the day.

There may be a good deal of *hæmorrhage* in some cases, even without the formation of a false passage or the production of any serious laceration of the mucous membrane ; it is most likely to occur in plethoric patients who have been drinking or eating to excess and in whom the urethral mucous membrane is much congested in the neighbourhood of the stricture, so that a mere touch with a soft instrument provokes bleeding. As a rule this trouble may be avoided if the patient is confined to bed for a few days before commencing the treatment, put on a low diet, and purged freely with salines. A 4 per cent. solution of novocaine, combined with a small quantity of adrenalin chloride (1 in 1000), may be injected, and after this has had time to act, it is well to fill up the urethra with sterilised oil so as to insure that the lubrication of the instrument is perfect. Soft instruments should be used in the early stages, but metal ones may be substituted when the stricture has been dilated up a few sizes.

The surgeon meets with *false passages* under two conditions : he may make them himself and be conscious of doing so, or they may have been made previously by another surgeon or unconsciously by himself. The existence of a false passage greatly complicates the case, for an instrument passed along the urethra almost invariably finds its way into the false passage, because the opening of the latter is more in the direct line

of the point of the instrument than is the passage through the stricture ; moreover, the orifice of the false passage is swollen and gapes. The surgeon can generally tell that the instrument is in a false passage by the fact that it passes well beyond the region of the stricture and yet meets with an obstruction and—if it is a metal instrument—cannot be rotated as it could be were it in the bladder ; the finger in the rectum will feel the tip of the instrument close beneath the rectal wall. If a catheter is used instead of a bougie, the failure to draw off urine also indicates that the instrument is in a false passage. A false passage bleeds freely immediately it is made, but instruments passed very gently along a false passage of some standing do not necessarily excite any bleeding. For the treatment of this complication, see p. 387.

Catheter fever is described on p. 414. It has been supposed by some that it is not the actual passage of the instrument through the stricture that gives rise to this condition but its contact with the prostatic urethra, and some surgeons have asserted that in patients who were subject to this complication they have avoided it by not introducing the instruments farther than just beyond the stricture. The best prophylactic is to keep the patient in bed for twenty-four hours before instrumentation, and to administer two five-grain doses of quinine shortly before it. After passing an instrument, the patient should be kept in bed, well covered up, and given a large warm drink—such as a pint of weak tea.

Epididymitis is a rarer complication of catheterisation, and generally results from direct infection from the urethra when the stricture has been fairly tight and has been split by dilatation. Its treatment is described in Chap. XXVIII.

Cases suitable for treatment by dilatation.—The majority of strictures can be treated by dilatation—at any rate, for a time—for, even if the treatment is not curative, it may be required as a preliminary to other operations, such as internal and some forms of external urethrotomy. Ordinary strictures in the vicinity of the bulbous urethra are very suitable for treatment by intermittent dilatation. Those in the penile portion are usually of a more resilient character and should be submitted to operation. A stricture may be said not to be suitable for this method when it is either so rigid as not to become absorbed after prolonged attempts by intermittent dilatation or is so resilient as to relapse each time ; there is then no alternative but to operate. Similarly, cases complicated by numerous false passages, by abscesses or fistulæ behind the stricture or by attacks of epididymitis and catheter fever are better submitted to operation. Finally, of course, the so-called impassable forms of stricture are not amenable to dilatation.

Urethrotomy.—This is the alternative to treatment by dilatation, and by it is meant division of a stricture either from within (internal urethrotomy), or from without (external urethrotomy).

Internal urethrotomy.—The cases suitable for internal urethrotomy are especially penile strictures of the resilient type. These may be dilated fully at one sitting, but at the next they are as narrow as ever, and no permanent progress is made by dilatation. Bridle or valvular strictures are also specially suited for treatment by internal urethrotomy as they do not yield to dilatation, and the same remark applies to irritable strictures. External urethrotomy is not a suitable operation for stricture in the penile portion of the urethra unless some complication, especially extravasation of urine, is present. Internal urethrotomy is only possible when the stricture can be dilated to at least the size of a 4 or 5 English, so as to allow the passage of the urethrotome.

The operation itself may be performed in two ways. In one the

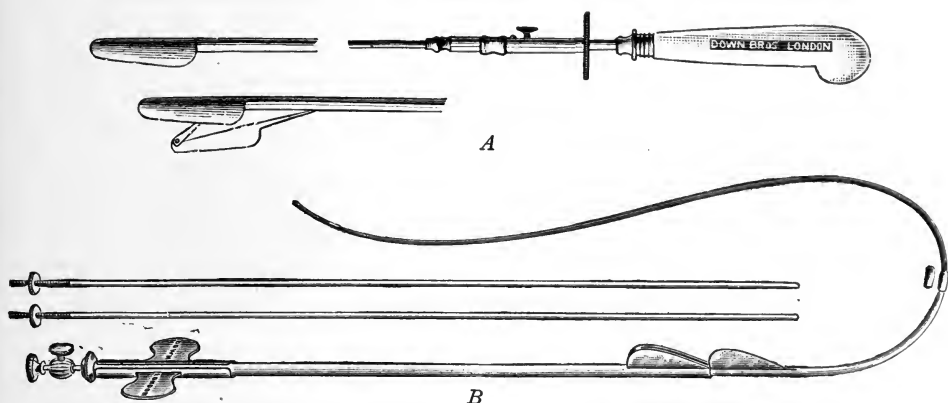


FIG. 106.—URETHROTOMES. *A* is Thompson's instrument, which cuts from behind forwards in the floor of the urethra. *B* is Berkeley Hill's, which cuts from before backwards in the roof of the urethra.

stricture is divided from before backwards, in the other, from behind forwards, and in both cases the incision in the urethra may be made either in the floor or in the roof. We prefer to divide the stricture from behind forwards and to make the incision in the floor of the urethra, as there is then less likelihood of doing unnecessary damage to the deep urethra and it is more easy to make certain of dividing the whole stricture. Another reason for making the incision in the floor of the urethra is that the main portion of the stricture is usually situated at that part; were the division made in the roof, only healthy mucous membrane might be incised and the stricture itself left untouched.

The patient should be prepared beforehand, and the stricture dilated sufficiently to admit the urethrotome. Thompson's instrument (see Fig. 106, *A*), which we prefer, corresponds to No. 5 English, and, therefore, the stricture must be dilated up to that size, either by the intermittent method or by tying in a catheter for a day or two previous to the operation; the former method is preferable as it is not so likely to set up urethritis

as the latter. Another important point is to render the urine as aseptic as possible, and this is done by the administration of urinary antiseptics (see p. 354) for a few days previously. The bladder should be washed out regularly with boric lotion (see p. 447), if there is any cystitis, and it should be emptied immediately before the operation.

The patient is anæsthetised, and the exact limits of the stricture are ascertained by means of the stricture-finders which accompany Thompson's instrument; these have a shaft graduated similarly to the shaft of the urethrotome and are furnished with a pyramidal head which is passed into the urethra until it rests upon the face of the stricture. The distance from the meatus is read off on the scale and the head of the instrument is then passed through the stricture and withdrawn until its shoulder is felt to hitch against its deep surface, when the distance from the meatus is again read off; by subtracting the former measurement from the latter, the length of the stricture is ascertained, as well as the distance of the anterior and posterior extremities from the meatus. The



FIG. 107.—URETHRAL SYRINGE. This has a backward flow so that infective material cannot be driven on into the deeper parts by it.

urethra should now be well washed out with 1 in 4000 sublimate solution with a back-flow syringe (see Fig. 107), and the urethrotome—which should be previously examined to see that it is in perfect order—is lubricated and passed through the stricture with its cutting-blade concealed and with the edge directed towards the floor of the urethra. The instrument is passed on until the surgeon knows by the measurements that its bulbous end lies behind the proximal extremity of the stricture. The button is then pressed, the knife is protruded, and the urethrotome is gradually and steadily withdrawn, firm pressure being made downwards on the floor of the urethra so as to divide the stricture fully. The forefinger of the left hand should make light pressure upon the perineum in the neighbourhood of the stricture in order to steady the soft parts and facilitate their division.

When the stricture has been fully divided—as is known by reading the scale upon the shaft of the instrument and also by the relaxation of the pressure on the blade—the latter is sheathed and the instrument is withdrawn. A 7-10 Lister's bougie is now passed, and the urethra rapidly dilated by a series of these instruments up to No. 14 English. Finally, the urethra is again flushed out with 1 in 4000 sublimate solution.

and a soluble bougie, containing iodoform, pushed down to the region of the incision and left there. It is well not to tie in a catheter as this is apt to set up urethritis, from which septic absorption may occur. There is no difficulty whatever in keeping the stricture from contracting if the urethra has been well dilated at the time of the operation and if metal bougies are passed subsequently from time to time.

When the patient requires to micturate he may do so spontaneously ; there is generally some scalding during the act, and it is well therefore to place him in a hot hip-bath or, if he is neurotic, to inject 20 minims of a 4 per cent. solution of novocaine down the urethra before the act. A full-sized metal bougie should be passed at the end of twenty-four to thirty-six hours, care being taken to keep the point well in contact with the roof of the urethra ; this should be repeated every few days for two or three weeks and then at longer intervals for two or three months. The patient need only be confined to bed for three or four days, and during that period should take one of the urinary antiseptics internally (see p. 354).

There are practically no accidents which are likely to follow this simple operation. Hæmorrhage is rare, and is easily controlled by an ice-bag to the perineum ; in severe cases a Leiter's tube may be coiled round the penis. It would appear that in many cases there is little tendency for the stricture to contract after division in this manner, but after three months an instrument should be passed monthly for the following six months, and then the patient should visit the surgeon two or three times a year in order to see that there is no recurrence. In favourable cases the periods may be lengthened after about two years, but it is always well for the surgeon to pass an instrument, at any rate, every twelve or eighteen months as a precautionary measure.

External urethrotomy.—Although internal urethotomy is of great value in a large number of cases, there are some for which it is not suitable. Thus, when the surgeon fails to introduce an instrument through a tight stricture, the only possible procedure is to divide the stricture through an external incision. Apart from these rare cases, however, there are others in which external urethrotomy should be resorted to, such as dense cartilaginous strictures in the vicinity of the bulb in which the stricture is tortuous and which will not yield to dilatation, extensive traumatic strictures, some cases of stricture with retention of urine, and most of those accompanied by perineal fistulæ. Cases accompanied by severe cystitis or by extravasation of urine also require this operation.

At the present time the two forms of external urethrotomy most often practised in England are Syme's and Wheelhouse's. Of these, Syme's is the easier, but it can only be done when an instrument can be passed through the stricture and the latter dilated up to the calibre of 3 or 4 English. This is the operation that should be chosen for all cases requiring external urethrotomy, in which these requirements can

be fulfilled ; when it is impossible to get an instrument through the stricture, or when the latter cannot be dilated up sufficiently to admit Syme's instrument, Wheelhouse's operation is called for. It is evident, therefore, that the latter operation has only a limited range.

Syme's perineal section.—The stricture is first dilated up to the size of a No. 4 English by the intermittent method if time permits ; if the case is urgent, however, the patient is anæsthetised and the stricture rapidly dilated with Lister's bougies until a Syme's staff (see Fig. 108) can be introduced. This staff consists of two portions : a terminal part about the calibre of a No. 4 English, and a shaft which has a No. 12 gauge ; at the junction of these two parts there is a well-marked shoulder. On the convexity of the curve of the narrower portion there is a groove which is prolonged a short distance into the shaft.

The staff is passed through the stricture until the shoulder hitches against the face of the stricture. The handle is then entrusted to an assistant, and the patient is brought down to the end of the table and placed in the lithotomy position. The assistant should hold the staff exactly vertical and pull the scrotum out of the way. The surgeon shaves and disinfects the perineum, and makes a median incision through the skin and fascia from the root of the scrotum to about an inch in front of the anus. After the superficial structures have been divided, a few touches of the knife expose the urethra, and then the groove in the narrow portion is felt for with the left forefinger, and the point of the knife is slipped over the nail of the finger until it perforates the urethra and engages in the groove. The knife is now made to cut upwards, dividing the stricture as it goes, and is carried to the full extent of the groove—that is to say, past the shoulder of the staff. If care is taken to enter the urethra behind the stricture, the entire strictured area must be divided if the knife is made to travel forwards as far as the groove extends, because the shoulder of the staff lies upon the face of the stricture.

The handle of the staff may now be depressed and the point of the instrument pushed on into the bladder. If the stricture has been completely divided, there will be no difficulty in doing this ; if there is, some fibres of the stricture have escaped and must be divided. All bleeding is arrested, the perineal wound is swabbed out with chloride of zinc



FIG. 108.—SYME'S STAFF FOR EXTERNAL URETHROTOMY.

solution (gr. 40 to the ounce), the staff is withdrawn, and a full-sized gum-elastic catheter bent to the proper urethral curve on a stylet is passed into the bladder and tied in, the point of the instrument being kept close along the urethral roof as it is passed.

It is sometimes difficult to pass the catheter into the bladder in this manner as, unless the point be kept closely in contact with the urethral roof, it is very apt to emerge in the perineal wound ; this is always likely to occur if a soft instrument is used. It is usually possible, however, to pass the instrument into the bladder with a little manipulation.

The bladder should never be drained through the perineal wound, and the latter should be left unsutured ; its edges fall together as the patient lies in bed and it heals rapidly. If sutures are used, only a few should be inserted in the anterior part, and enough of the wound should always be left open to insure the free escape of any urine that may find its way alongside the catheter, otherwise extravasation may occur into the cellular tissue. The dressings are kept in position by a T-bandage. The catheter is tied in by one of the methods described on p. 342.

The catheter should remain unchanged for three days, when it may be left out. If the stricture has been extensive, there is no objection to tying in a second catheter for two days, so as to make sure that the passage remains more or less rigid after the withdrawal of the instrument. After the catheter is finally withdrawn the patient is allowed to micturate naturally ; at first the urine will pass almost entirely by the perineal wound, but the amount passing by the urethra will steadily increase, until finally it all passes in the normal direction and the perineal wound heals, as a rule, in about six weeks. A week after the operation the surgeon should pass a full-sized metal instrument into the bladder, and this should be repeated every third day until the wound has healed. The instrument must be passed very gently, the point being kept in close contact with the roof, otherwise it will pass out through the perineal wound and open it up ; a soft instrument should not be passed until the wound has healed. Instruments should be passed at regular intervals after healing is complete ; in the first place they should be passed weekly, but the interval may be gradually increased to a fortnight, three weeks, and so on, until, after about a year, the patient need only have an instrument passed once in six months unless the stricture shows signs of contracting. The results of this operation are very satisfactory ; any tendency to relapse is easily guarded against by the occasional passage of an instrument.

Wheelhouse's operation.—When the surgeon fails to pass an instrument through the stricture or when the necessary time cannot be devoted to preliminary dilatation of the stricture, Wheelhouse's operation must be employed.

The perineum is shaved and disinfected and a Wheelhouse's staff (see Fig. 109) is passed down to the face of the stricture with its

grooved surface towards the floor. The patient is then placed in the lithotomy position on a table immediately in front of a window in a good light. An assistant takes charge of the handle of the staff and makes the lower end prominent in the perineum by pushing it down, while the surgeon, sitting with his back to the light, cuts down on the end of the staff in the perineum. The exact position of the incision will depend upon the seat of the stricture, but it usually extends from the mid-point of the perineum forwards for about an inch to an inch and a half—that is to say, the strictures requiring Wheelhouse's operation are usually situated in the bulbous or the membranous portions. The tissues are incised until the urethra is exposed, when the lower end of the staff is felt and the urethra is opened upon the groove in it by a single clean cut extending downwards to its end. It will be noticed that the groove in the staff does not extend quite to the lower end of the instrument. It is important for the success of the operation that the incision in the urethra should not reach quite down to the edge of the stricture otherwise the guide formed by the floor of the urethra would be lost.



FIG. 109.—WHEELHOUSE'S STAFF FOR EXTERNAL URETHROTOMY.

The edges of the slit in the urethra are now seized in fine catch-forceps or a thread is passed through them on each side, and the staff is turned round so that the hook projects through the opening; it is then pulled up slightly so as to cause the hook to catch in the upper angle of the wound and put it on the stretch. When full retraction has been made, a triangular or somewhat lozenge-shaped wound appears in the urethra, at the bottom of which the surgeon looks down upon the face of the stricture. A good plan is to retract the cut edges of the urethra with threads fastened to the skin of the buttock on each side.

All oozing is now carefully stopped, and the orifice through the stricture is sought for with a fine probe or a canaliculus director. This is the most difficult part of the operation, and it is often a matter of the greatest trouble to detect the passage. The best plan is to pass the probe along the roof of the urethra and, if this fails, a useful procedure is to press upon the bladder above the pubes, when the escape of urine through the stricture will give a clue to its orifice; it is therefore well not to have the patient's bladder emptied before the operation. Immediately the orifice is detected, a probe is slipped in along it and kept in position. A powerful light is essential, as well as great patience and careful spotting.

After a probe has been passed through the stricture, the rest is comparatively easy. If a canaliculus director is used, a fine probe-pointed

tenotome or canaliculus knife is passed into its groove and the stricture is slit downwards throughout its length and the canal stretched until it admits a full-sized bougie. If a probe has been used, it is almost equally easy to insinuate a tenotome or a fine canaliculus knife alongside it and slit up the stricture in a similar manner. When all the bleeding has been arrested, a full-sized catheter is passed into the bladder from the external meatus and tied in position. The edges of the perineal wound are allowed to fall together and the dressings and after-treatment are the same as for Syme's operation (see p. 384). If any stitches are inserted, they should be merely one or two fine absorbable catgut sutures in the urethra and peri-urethral tissues. The skin-wound and superficial parts should be left open.

It may be impossible, in spite of every effort, to find a track along which the probe may be passed, or so much time may be consumed in searching for it unsuccessfully that something must be done to terminate the operation more speedily. Under these circumstances the best plan is to expose and open the membranous urethra behind the stricture; the point of a curved probe may then be passed through the stricture from behind forwards and the latter divided as above. Some surgeons prefer to perform a Cock's perineal section (see p. 390) under these circumstances, whilst others open and drain the bladder above the pubes; in both cases the treatment of the stricture is left to a subsequent period.

Treatment of strictures accompanied by complications.

—(a) **Of strictures complicated by false passages.**—When the surgeon has made a false passage, instrumental treatment should be abandoned for two or three weeks, the patient kept in bed for a few days, allowed to micturate spontaneously, and a urinary antiseptic (see p. 446) administered by the mouth. Extravasation of urine rarely follows the formation of a false passage unless the latter is behind a stricture or between two strictures (see p. 373). The false passage will generally close in about three weeks and then treatment can be begun again. Metal instruments must be used when instrumental treatment is resumed; the urethra should be put fully on the stretch, the instrument passed very gently, and its point kept well under control.

When the false passage is of some standing, and especially when there is more than one, the surgeon may have the greatest difficulty in passing an instrument; it enters one false passage after another and it seems impossible to avoid them. The best plan then is to pass a number of fine bougies in succession and, when the first passes into a false passage, to leave it there and pass a second, which will probably either enter the same passage if it is large, or another, and to continue this until all the false passages are occupied. Finally, another instrument may find its way through the stricture. If this one succeeds, it is held in position

and all the others are withdrawn; and the surgeon can then either perform an external urethrotomy at once, using the filiform bougie as a guide, or he may tie in the bougie for twenty-four or forty-eight hours in order to effect continuous dilatation. There need be no hesitation in tying in a bougie in these cases as it is a small instrument and will not entirely block the stricture and the patient can pass urine alongside of it. A fine bougie is much better than a fine catheter if soft instruments are being used; the latter is so fine and is so readily blocked that it is of little use for draining off the urine, while it is very rare for a stricture to grip a fine bougie so tightly that the urine cannot pass alongside it. When once the stricture has been dilated sufficiently, the surgeon can usually avoid passing the instrument into false passages subsequently as he knows the direction of the canal; moreover, the orifice of the stricture will probably then be larger than that of the false passage.

(b) Of strictures accompanied by severe cystitis.—When a patient with a stricture has had cystitis, the first indication is to provide for free drainage of the bladder. For these cases intermittent dilatation is unsuitable, partly because of its slowness and partly because of the risk of infection of any accidental crack of the mucous membrane by the foul urine.

When the stricture is not dense or extensive, the simplest plan is to anæsthetise the patient, dilate the stricture rapidly up to a No. 7 or 8, and then to tie a catheter of that size into the bladder. Through this the urine can escape readily and the bladder may not only be kept drained but may be washed out if necessary, while the presence of the catheter insures dilatation of the stricture. It is always best to give an anæsthetic, as spasm and straining are done away with and a larger-sized instrument may often be passed than would otherwise be possible. Special care must be taken to see that only the eye of the catheter lies in the bladder (see p. 343), otherwise its end may impinge against the mucous membrane and cause spasm and ulceration. In simple cases treated on these lines the cystitis will pass off in a few days and the treatment of the stricture may then be carried out by intermittent dilatation.

When, however, the urine is very foul, it is possible that the mere retention of an instrument in the stricture will cause much irritation; and under these circumstances external urethrotomy, preferably by Syme's method, will give better results, as it will enable a larger-sized instrument to be tied into the bladder and will therefore facilitate drainage.

(c) Of strictures complicated by acute epididymitis.—The treatment for epididymitis is described separately (see p. 293). It is well not to attempt to dilate a stricture during the acute stage of the affection. When the acuter symptoms have subsided, either intermittent dilatation or external urethrotomy should be employed.

(d) Of strictures accompanied by retention of urine.—Acute retention of urine—that is to say, complete inability to pass water—

may be due to many other causes besides stricture of the urethra. We shall here only describe the treatment of retention due to organic stricture; for that caused by congestive and spasmodic stricture, see pp. 395 *et seq.*

The retention of urine in organic stricture is not entirely due to the narrowness of the stricture; even an extremely tight one will allow some urine to pass. In bad cases, however, inflammation of the urethral mucous membrane in the vicinity is very commonly present, more especially if instruments have been roughly employed, and the result of the inflammatory swelling is to cause complete, though temporary, blocking of the urethral canal. Hence the retention is usually associated with a congestive inflammatory condition in the neighbourhood of the stricture, and frequently also with spasm of the urethral muscles.

Unless the distension of the bladder is very urgent, the first measures should be directed towards the relief of the spasm and congestion; suppositories containing half a grain of morphine and a quarter of a grain of belladonna should be given, and the patient placed in a hot hip-bath. This will frequently result in spontaneous evacuation of the bladder. If, however, the distension of the bladder is so great that it is obviously necessary to relieve the patient without delay, the surgeon must take more speedy measures to relieve it, and in the first instance must try to pass an instrument through the stricture. The first instrument employed should be a bougie, either soft or firm according to the predilection of the surgeon; it should not be a catheter. A fine catheter is unduly flexible; and the difficulties of getting it through a tight stricture are almost insuperable; moreover, the passage of a very fine catheter is of little use for the purpose of evacuating the bladder, as the flow through it is so slow that it may not even keep pace with the secretion of urine and no relief is obtained. The best plan is to dilate the urethra in the first place by means of bougies passed while the patient is under an anæsthetic. For this purpose either Lister's or some form of tapering whip bougie should be used. If a bougie can be passed, the stricture may be quickly dilated up to a No. 4 or 6; and then a catheter of this size should be passed and tied into the bladder for twenty-four hours. This not only evacuates the bladder but produces continuous dilatation and, by the time the instrument is withdrawn, the patient can micturate naturally and the stricture becomes amenable to intermittent dilatation.

When, however, instruments cannot be introduced—and this is especially likely to be the case when false passages are present—some other procedure must be adopted. The surgeon has at his disposal supra-pubic aspiration of the bladder or Cock's perineal section which opens the urethra behind the stricture.

Aspiration.—This plan is the simpler, especially if the surgeon is summoned in a hurry at night, as is frequently the case, and has not

the necessary appliances, assistants, and instruments. Moreover, it is frequently found that after a simple aspiration the congestion of the stricture is relieved and the patient can subsequently pass water naturally, especially if he is placed in a hot bath. It is even well to aspirate the bladder (see p. 397) on two or three occasions before proceeding to more severe measures, unless there is some definite reason for preferring to deal radically with the stricture by operation.

Cock's operation.—Cock's perineal section, which was originally introduced for the cure of perineal urinary fistulæ complicating stricture, but which is also very useful for relieving acute retention caused by a dense and extensive stricture, aims at opening the urethra behind the stricture without touching the latter. As the stricture is always in front of the prostatic urethra, the operation consists in opening the urethra at the apex of the prostate. This is not so difficult an operation as might be thought, for the membranous urethra is so dilated in

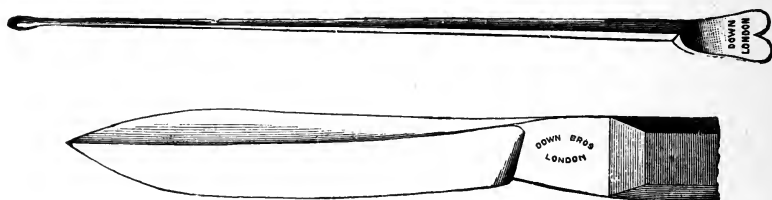


FIG. 110.—DOUBLE-EDGED KNIFE AND PROBE-POINTED DIRECTOR FOR COCK'S PERINEAL SECTION.

long-standing tight strictures that it is not easily missed if the knife is kept strictly in the middle line.

The operation is performed as follows: The patient is anæsthetised and placed in the lithotomy position with the symphysis pubis, the umbilicus, and the chin in the same straight line. The left forefinger is introduced into the rectum with its palmar surface upwards and its tip pressed firmly against the apex of the prostate. Cock's double-edged knife (see Fig. 110) is then thrust into the middle line of the perineum at a point about half an inch in front of the anus and pushed steadily onwards towards the tip of the finger in the rectum, the long axis of the knife being kept horizontal until the finger in the rectum feels that there is nothing between it and the edge except the rectal wall; the sensation of the loss of resistance as the knife divides the triangular ligament is very characteristic. The urethra will then have been opened as it emerges from the apex of the prostate, and if the apex of the gland is also incised, as is frequently the case, it apparently does not matter. The knife is now withdrawn, the left forefinger being kept in position, and the incision in the skin and superficial parts is slightly enlarged upwards and downwards by a sawing movement of the blade as it passes out. A

probe-pointed, broad director (see Fig. 110) is passed through the incision to the apex of the prostate, where it enters the urethra and so reaches the bladder. Along this a No. 12 gum-elastic catheter is passed and tied in, so as to drain the bladder through the perineal opening.

Hæmorrhage is slight and can be controlled easily by pressure. The wound should be sponged with chloride of zinc solution (gr. 40 to the ounce) and a long india-rubber tube attached to the catheter so that the urine is drained off continuously; no attempt is made to deal with the stricture for several days. At the end of a week or ten days, when the condition of the bladder has improved, the congestion about the stricture will probably have diminished sufficiently to allow catheterisation to be effected and then the stricture becomes amenable to the ordinary treatment.

(e) **Of strictures complicated by peri-urethral abscess.**—When the urethra behind the stricture becomes dilated and inflamed, ulceration may occur and infective material may spread, either through the ducts of the mucous glands or through some abrasion in the mucous membrane, into the peri-urethral tissues and there set up an abscess which in the first instance may be shut off from the urethra. As it increases in size, the abscess spreads towards the urethra on the one hand and the skin on the other, and generally ends by bursting first into the urethra and afterwards through the skin. The result of this is a perineal urinary fistula. It is not uncommon for other abscesses to form, and in this way several external openings may be formed; as a rule there is only one orifice in the urethra to which they all lead. These peri-urethral abscesses often commence in Cowper's glands.

When the abscess bursts into the urethra early, urine finds its way into the abscess cavity—the condition sometimes spoken of as a urinary abscess—and this results in rapid increase in the inflammatory condition. If only a small quantity of urine finds its way into the abscess cavity, a urinary fistula will form when the abscess makes its way through the skin; sometimes, however, the opening into the abscess is wide and urine enters freely, and then, when the patient micturates, the pressure in the abscess may be very great if the structure is tight, and the wall may give way and sudden extravasation of urine (see p. 394) may take place.

Peri-urethral abscesses usually form in the perineum below or behind the urethra and cause much pain. Rigors generally occur and all the symptoms of acute inflammation are present. When the abscess bursts into the urethra pus flows from the meatus, sometimes independently of micturition, sometimes only when the patient urinates if the stricture is very tight.

The earlier these abscesses are opened by the surgeon from the outside the better, and if this can be done, and the stricture dilated at the same time, no urinary fistula may form. In some cases, however, the abscess is situated close to the urethra, and, even though the abscess is incised before it has burst into the urethra, the thinned mucous membrane will

give way subsequently and a urinary fistula will follow ; on the other hand, the abscess may burst into the urethra quite early. Any brawny tender swelling in the perineum in connection with a stricture should therefore be incised at once, and a drainage tube inserted ; nothing further need be done immediately, provided that the patient can pass water fairly freely. After a few days, however, a Syme's external urethrotomy (see p. 384) should be performed. If on the other hand the stricture is very narrow, it may be better to perform external urethrotomy when the abscess in the perineum is opened.

(f) **Of strictures complicated by perineal fistulæ.**—The mode of origin of perineal fistulæ in connection with peri-urethral abscess has just been described. Urinary fistulæ may also follow extravasation of urine (see p. 394) and are then much more serious, as they are associated with fairly extensive loss of tissue, so that, instead of a small fistulous orifice into the urethra, as is usually the case when a fistula follows a peri-urethral abscess, there may be a large defect in the urethral wall. Other causes of perineal urinary fistulæ are external urethrotomy and injuries of various kinds. Tuberculous prostatic abscess occasionally gives rise to fistulæ, and fistulæ may also occur in connection with carcinoma.

These fistulæ are generally situated in the perineum and may be divided into those in which the communication is between the urethra and the skin, and those in which there is a communication between the urethra and the rectum, with or without a perineal opening. The latter condition either follows an operation, such as lithotomy accompanied by wound of the rectum, or may occur in connection with a prostatic abscess which has burst into the rectum.

In *penile fistulæ*, which are fortunately rare, there is often great difficulty in obtaining closure of the opening, as the mischief is generally accompanied by sloughing of the urethra. When the fistula is primarily due to stricture of the urethra, the stricture should be dilated first and then the fistula may close rapidly ; in many cases, however, it will not do so, as epithelium has spread from the urethra to the skin. It will then be necessary to pare and bring together the edges of the fistula and also to raise a flap to cover the opening, especially when the fistula has followed extensive extravasation of urine and when there is consequently considerable loss of the urethral wall. The operations for this purpose are mostly modelled upon the operations for hypospadias (see Chap. XXXII.). When the loss of tissue is not great, a flap may be turned in with its raw surface forming the new floor of the urethra, a catheter being tied in. In other cases two superimposed flaps may be necessary, the cutaneous surface of the deeper one forming the floor of the urethra. No particular rules can be laid down ; the surgeon will have to devise the operation for himself in most cases. If union fails at any point, a smaller fistula will be left and this may sometimes be made to unite by

touching the defect with a hot wire or a cautery point, or a second plastic operation may be needed, in which case the edges should be pared and brought together by sutures.

When the fistula is situated in the perineum and is connected with a stricture in front of the bulb, there is no chance of healing until the stricture has been cured. When it follows a peri-urethral abscess, dilatation of the stricture will often suffice, and therefore the treatment should be directed first to this point. As the stricture becomes fully dilated, less and less urine passes through the fistula until finally it heals.

Sometimes, however, dilatation may fail even though carried to its full extent, as the tissues may be very rigid or the direction of the fistulous opening may be such that the urine continues to escape easily through it. Here the best plan is to perform a Syme's urethrotomy, dividing the stricture completely, and enlarging and scraping the fistula.

The fistulae will generally be got to heal by one of these means, except when they have followed extensive sloughing due to extravasation of urine. Here some form of plastic operation on lines similar to those for hypospadias (see Chap. XXXII.) may be called for, and in addition it will generally be necessary to drain the bladder so as to prevent urine passing over the wound. Under these circumstances supra-pubic drainage (see p. 473) should be established and the perineal condition treated by an external urethrotomy, dividing the stricture freely, paring raw surfaces or turning in flaps according to the circumstances of the case; if a catheter were simply tied in, urine would almost certainly escape beside it and lead to failure of the operation.

Cases in which there is *a communication between the rectum and the urethra*, with or without a perineal opening, are very difficult to treat. As a rule the communication with the rectum is just above the sphincter, and liquid faeces find their way into the urethra, while urine escapes into the rectum; if there is a perineal opening, both urine and faeces may come through it. The wall of the fistula soon becomes lined with epithelium and there is no possibility of spontaneous healing, so that a comparatively elaborate operation, separating the urethra from the rectum and then suturing each canal separately after paring the edges of the opening into it, must be undertaken for its cure. This is best done through a crescentic incision in front of the anus which is deepened so as to reach the interval between the urethra and the rectum, the former structure being defined by a sound passed into the bladder. The rectum should be pulled well backwards. The fistulous tract must be divided as it is defined, leaving as much of the mucous membrane as possible on the urethral side, as the latter is most likely to be narrowed by a plastic operation, whereas slight narrowing of the rectum is not of much importance. The opening into the rectum is inverted and closed by sutures inserted on Lambert's plan, and that in the urethra is similarly treated. The greatest care must be taken to prevent urine passing into the wound,

and, when the orifice of communication is extensive, it may be advisable to carry out supra-pubic drainage for a time. The sphincter ani must be fully dilated so that there shall be no obstacle to the exit of fæces. If a stricture of the urethra exists it must be treated in the ordinary manner.

(g) **Of strictures complicated by extravasation of urine.**—Extravasation of urine following a peri-urethral abscess is described on p. 391. Many cases, however, occur without any previous urinary abscess, the wall of the urethra becoming thinned and giving way either as the result of some local injury, such as a blow, or of excessive straining; when the patient attempts to pass water, the urine passes into the peri-urethral tissues. In both these cases the opening in the urethra is usually in front of the triangular ligament, but when it is associated with urinary abscess it may be behind that structure. The urine, however, quickly finds its way to the front of the triangular ligament, where it forms a swelling limited by the attachments of the deep layer of the superficial fascia; this is attached to the lower margin of the triangular ligament behind and to the rami of the pubes on either side, so that the urine does not extend backwards beyond the middle point of the perineum, but forwards into the scrotum, along the penis, and up on to the anterior abdominal wall, being prevented from passing down into the thighs by the attachment of the fascia to Poupart's ligament. Occasionally, extravasation occurring in connection with a urinary abscess deep to the triangular ligament may pass backwards and form an ischio-rectal abscess. Sometimes it passes up between the bladder and the posterior surface of the symphysis and forms a brawny swelling in the hypogastric region.

At the moment of extravasation of the urine there is often a feeling of great relief, as the patient gets rid of a certain quantity of urine from the distended bladder, although this passes into the tissues and not through the meatus. This feeling of relief is quickly followed by a burning pain in the perineum, and a swelling about the scrotum and penis is noticed almost immediately if much urine has been extravasated. The extravasated urine, which is generally very septic, sets up symptoms of acute cellulitis within an hour or two, the pain increases, the patient develops a high temperature—probably with rigors—the perineum, scrotum, and penis become much swollen and, unless immediate relief is afforded, sloughing occurs and death may result from septic absorption.

Free incision and evacuation of the extravasated urine must be carried out as soon as the diagnosis is made. No palliative treatment is possible; delay can only result in widespread sloughing of the wall of the urethra, the deep tissues and the skin, and usually in the death of the patient. Free incisions must be made into every infiltrated area. Usually a long, free median incision with a lateral incision on each side, extending from the front of the anus right up into the scrotum, is

required, together with incisions along either side of the dorsum of the penis, and free incisions into the abdominal wall. If this is done quite early after the extravasation, the tissues will not be very severely damaged and recovery may occur with very little sloughing. If, however, several hours have elapsed, the sloughing will be extensive.

A free exit for the urine from the bladder must also be established, and an immediate external urethrotomy should be done if the patient's condition is at all good. If however the patient is very ill, the opening in the urethra behind the stricture should be identified, if possible, and should be enlarged to allow of the free passage of urine. In these gangrenous cases a catheter should not be tied into the bladder, as cystitis may be set up and may lead to the death of the patient, whereas by increasing the opening in the urethra the patient will micturate readily through the perineal wound. Even when an external urethrotomy has been done, an instrument should not be tied in, but the wound left open until the sloughs have separated.

In these cases some surgeons prefer to perform Cock's perineal section (see p. 390). This need only be done, however, when it is impossible to identify the opening through which the extravasation has taken place.

The wounds should be left open, powdered with iodoform, and stuffed with cyanide gauze. Large boric fomentations should be applied outside and must be changed frequently. When the sloughing is extensive it is an excellent plan to keep the patient in a warm bath until the sloughs have separated, changing the water frequently and maintaining its temperature.

SPASMODIC STRICTURE.

Complete retention of urine may occur without any organic change in the coats of the urethra and may be caused by reflex spasm of the extrinsic muscles of the urethra from irritation elsewhere; the membranous urethra is practically always the part affected. The condition is frequent after various operations, such as those about the anus, perineum, or genital organs. It may also occur after operations elsewhere, especially in hysterical subjects, and spasmodic retention of urine may occur in women without any apparent cause.

TREATMENT.—Whatever be the cause of this condition, the treatment is directed on the one hand to the relief of the retention and on the other to allaying the spasm. The best way of allaying spasm is to apply hot fomentations to the pubes and perineum, or to place the patient in a hot bath and give him a morphine suppository. In many cases, however, it is neither possible nor advisable to place the patient in a hot bath, nor is it desirable to wait for the effects of morphine, and there is no objection to relieving the retention at once by means of a catheter. When, however, the cause is hysteria, it is well to employ the

other remedies first, and to refrain as long as possible from using a catheter; should it be necessary to resort to it, a red-rubber Jaques's catheter, sterilised by boiling and passed with all the precautions recommended on p. 374 should be used. The instrument should be a No 8-10 English. As gentle pressure may be necessary to overcome the spasm, a black olivary catheter may have to be employed; with patience, however, Jaques's instrument can generally be passed.

As a rule there is no difficulty in passing the catheter as far as the membranous urethra, but when it reaches the opening in the triangular ligament it becomes arrested by the spasm, which is probably increased for the moment by the contact of the point of the instrument. Steady pressure should be kept up against the obstruction without moving the catheter, and in the majority of cases the spasm will relax and the instrument pass on into the bladder. Occasionally the catheter becomes arrested again in the prostatic portion from spasm at the neck of the bladder; in some cases the spasm appears to be entirely in this situation. Steady pressure will usually succeed, whereas twisting or pushing the catheter is apt to increase the spasm.

A suppository containing morphine and belladonna should be administered after the bladder has been evacuated, hot fomentations applied over the pubes and perineum, and the patient given hot drinks and kept in bed; he is usually able to pass water the following morning. If this is not the case, the bladder should be evacuated with a catheter three times a day until the spasmodic condition has passed off; with few exceptions the spasm does not last longer than the second or third day after an operation. Some patients, however, are very nervous and cannot pass water after an operation until they are allowed to stand up or, at any rate, to micturate when upon the hands and knees. The period at which this will be allowed is determined by the nature of the operation.

CONGESTIVE STRICTURE.

The typical example of this condition is acute retention of urine occurring during the course of gonorrhœa; it is essentially a combination of congestion of the mucous membrane with spasm of the extrinsic muscles of the urethra. The swollen mucous membrane offers a certain amount of impediment to the passage of urine, and the obstruction is completed by the spasm which is due to the irritation of the inflammatory condition. As a rule the spasm subsides easily if the congestive condition can be got rid of.

TREATMENT.—In these cases, the passage of an instrument along the urethra is a serious matter and should be avoided if possible, because it increases the irritation and, owing to the congested condition of the mucous membrane, may cause hæmorrhage. The pain and spasm

are increased rather than diminished by it, and, moreover, in gonorrhœa the gonococci are almost certain to be carried back and deposited in the neighbourhood of the prostate or in the bladder itself, so that acute prostatitis or cystitis may be set up. Hence every effort should be made to relieve the spasm without passing instruments. This is best done by giving a suppository containing half a grain of morphine with a quarter of a grain of extract of belladonna, and placing the patient in a hot bath, in which he should stay until he feels faint; he should be encouraged to pass water in the bath. The bowels should be cleared out by five grains of calomel.

If this fails, the bladder must be relieved by some mechanical means, and we prefer *supra-pubic aspiration* to the use of a catheter in gonorrhœal cases. There is no objection to aspiration in these cases because the bladder is distended, so that the peritoneum is lifted well up from the symphysis and there is no risk of puncturing it, while, if a fine aspirating needle is used there is no extravasation of urine into the pre-vesical space.

The operation is simple and is done as follows. The parts are shaved and disinfected in the usual manner, and a fine aspirating needle is thrust through a small nick in the skin immediately above the symphysis pubis, and is directed backwards and slightly downwards; the sudden cessation of resistance will show at once when the needle has reached the bladder, and urine will issue directly. A fine needle should be employed, and it should be provided with an inner tube so as to avoid lacerating the opposite wall of the bladder as the organ empties; in inserting the needle, it is well to place the forefinger upon it, about an inch from its point, in order to prevent its being thrust in too deeply.

The first portion of urine will escape without aspiration, but the last should be withdrawn by attaching the bottle of the aspirator. When the bladder has been emptied, a dram of boric lotion is syringed down the canula to clear it of urine and the canula is withdrawn, a collodion dressing applied to the small puncture, the patient put back to bed with hot fomentations to the perineum and hypogastrium, and a morphine and belladonna suppository administered. The congestion will often pass off in a few hours, and the next time the bladder becomes full the patient may be able to empty it spontaneously. There is no objection, however, to repeating the aspiration if necessary.

CHAPTER XXXVII.

INJURIES AND INFLAMMATORY AFFECTIONS OF THE PROSTATE.

INJURIES.

INJURIES from external violence are very rare, and are usually caused by falls upon pointed instruments or by severe contusion of the perineum ; the prostate may also be injured during the passage of instruments into the bladder. The chief dangers of these injuries are extravasation of urine and septic infection, the latter being particularly prone to occur owing to the large size of the venous prostatic plexus.

TREATMENT.—The main points in treatment are to provide free drainage and to take measures for securing asepsis of the urine.

When the injury is due to severe contusion of the perineum, there may be so much swelling around the urethra as to render drainage of the bladder by a catheter difficult, and it will then be best to perform a median perineal section (see p. 348), and drain the bladder by a perineal tube. This may be left out in ten days or a fortnight, a catheter tied into the bladder through the urethra (for details see p. 342), and the perineal wound allowed to heal. Should the prostate be very severely damaged, it may be difficult to pass a catheter, or even to find the way into the bladder after a perineal section ; under such circumstances, the best plan is to open the bladder above the pubes, when the vesical orifice of the urethra can be identified, and a bougie passed downwards through the urethra, to which a catheter may be attached and pulled up from below (see p. 342). Urinary antiseptics (see p. 446) should be given and the bowels kept freely open ; morphine and belladonna suppositories may be required for the relief of pain.

INFLAMMATORY AFFECTIONS.

Inflammation of the prostate may be either acute or chronic, the acute form affecting either the glandular follicles or the organ as a whole. When suppuration occurs, the abscess is sometimes peri-prostatic.

ACUTE PROSTATITIS.

This is an infective condition often connected with gonorrhœa and then due to the gonococcus ; it may also be due to bacillus coli infection. In other cases, the inflammation may result from injury to the prostatic urethra by dirty instruments or after a surgical operation ; it may follow the use of unduly strong urethral injections, while gout, alcohol, and dietetic excess seem to play some part in its production. The condition may also be set up by the presence of vesical or prostatic calculi, and it may occur in connection with stricture of the urethra ; excessive exercise—such as bicycling and horse-riding—and sexual excess, may also predispose to its occurrence.

In the cases which are not due to sepsis, resolution generally occurs when the cause is removed. When of gonorrhœal origin, the acute form may pass on into the chronic, while in septic cases suppuration is common. Suppuration may commence in connection with the follicles, in which case the abscess usually bursts into the urethra, or in the peri-prostatic tissues, when the pus finds its way into the rectum, the ischio-rectal fossa, or the perineum. In rare cases, a communication may form between the urethra and the rectum or the perineum, and a urinary fistula may result.

The earliest *symptom* is usually a sensation of heat and weight in the rectum, with frequent micturition and painful defæcation. The patient cannot get comfortable in any position, and there may be marked pyrexia. On digital examination *per rectum*, the prostate is found enlarged and very tender. When suppuration is occurring, the pyrexia becomes more marked and rigors may occur. Retention of urine is common, and the passage of a catheter causes great pain ; the tenderness of the prostate on rectal examination increases, and a soft spot may be felt when suppuration is established. When prostatitis occurs in patients who are suffering from urethritis, the urethral discharge usually diminishes in amount or ceases altogether. A bacteriological examination of the pus and of the urine should always be made.

The condition is easily distinguished from gonorrhœal cystitis, in which there is marked vesical tenesmus, but no enlargement of the prostate.

TREATMENT.—The patient should be confined to bed so as to keep the parts at rest ; on account of the intimate connection of the prostate with the levator ani, any movement will affect the gland. The pelvis or the foot of the bed should be raised, the bowels should be kept freely open, first with a dose of calomel (gr. iii-v), and subsequently with sulphate of magnesia administered daily, while suppositories of belladonna and morphine should be introduced into the rectum once or twice daily to relieve pain and diminish the contractions of the levator

ani. Hot perineal fomentations or a sitz bath as hot as the patient can bear it, should be used as frequently as possible. If a bath is employed, the patient should sit in it for from half an hour to an hour at a time, the water being renewed as often as may be necessary in order to keep it up to the proper temperature. If these measures do not give relief, half a dozen leeches may be applied to the perineum, followed by hot boric fomentations and large enemata of hot water (100°–105° F.). The diet should consist of milk, and large quantities of diluent drinks may be given. Alcohol should be avoided, and urethral medication should be stopped. The following mixture may be given:—

R	Vini antim.	.	.	.	.	℥x.
	Potass. bromidi	.	.	.	.	gr. xxv.
	Tinct. hyoscyami	.	.	.	.	ʒss.
	Infus. buchu	.	.	.	.	ad ʒj.

Every three hours.

A catheter should not be used unless absolutely necessary; if required, a 4 per cent. solution of novocaine should first be injected into the urethra, and a flexible instrument should be used. Digital examination of the prostate must be avoided as much as possible during the acute stage, but it may be necessary from time to time in order to ascertain if an abscess is forming.

If this treatment fails to relieve the symptoms, it will probably mean that suppuration is occurring; this may also be indicated by softening in the prostate when examined *per rectum*, or, in cases of peri-prostatitis, by swelling in the perineum. As soon as there is definite evidence of suppuration, the abscess should be opened from the perineum; if left alone, it may burst into the urethra—which is usually the case with follicular abscesses—or into the rectum, or it may spread towards the perineum or the ischio-rectal fossa. Early operation is necessary in order to prevent the abscess from bursting into the rectum, as serious and protracted suppuration may result if it does so. The abscess should not be opened from the rectum.

Operation.—Before opening a prostatic abscess from the perineum, the latter should be shaved and disinfected, and the patient anaesthetised and placed in the lithotomy position. The forefinger of the left hand is introduced into the rectum with the palmar surface upwards and its tip resting upon the apex of the prostate, or upon any fluctuating spot previously detected. A sharp double-edged knife, such as Cock's (see Fig. 110), is then thrust into the median raphe of the perineum about an inch in front of the anus, and pushed steadily onwards towards the tip of the finger in the rectum. The patient should lie with the symphysis pubis, the umbilicus, and the point of the chin in the same straight line, and the long axis of the knife should be kept in this line. As soon as its point is felt to enter the capsule of the prostate, the knife is withdrawn,

the skin wound being enlarged upwards and downwards by a sawing movement as this is done, and a pair of sinus-forceps is pushed into the abscess through the perineal opening ; the finger is kept in the rectum until the pus is reached. As soon as pus begins to flow, the finger is withdrawn from the rectum and a fresh glove put on, and then the abscess cavity is opened up, the finger of the right hand being introduced into it in order to break down any septa that may be present. A large drainage tube (No. 14) should be introduced into the cavity and stitched to the skin of the perineum. The urethra should not be opened in this operation, although it may give way subsequently from sloughing of the thinned mucous membrane. If it does, a urinary fistula will follow, but it generally closes as the abscess contracts. Any hæmorrhage may be controlled by packing gauze firmly around the drainage tube. Should much packing be required, the tube should be of gum-elastic material instead of india-rubber, so that its lumen is not closed by the pressure.

Another and perhaps better method of reaching the abscess is through a transverse curved incision midway between the anus and the bulb of the urethra. The median raphe is divided, and, after the peri-rectal fat has been exposed, the left forefinger is introduced into the rectum and serves as a guide ; a pair of sinus-forceps is then pushed upwards in the peri-rectal fat until the capsule of the prostate is reached. When the forceps penetrate the wall of the abscess, the blades are widely separated, any septa crossing its cavity are broken down by the finger, and a large drainage tube is introduced.

If the abscess has burst into the rectum before the patient is seen, the anus should be fully dilated, a large bivalve speculum introduced, and the opening of the abscess exposed and enlarged so as to give free exit to the pus. The opening in the rectum should be stuffed with strips of iodoformed gauze to prevent it from closing. After the third day the stuffing may be left out, and the rectum should be irrigated daily with saline solution after the bowels have acted, in order to prevent fæcal material collecting about the opening. It is not advisable to make a perineal incision in these cases, as a fæcal fistula would probably occur.

Should a perineal urinary fistula have formed, the sinus should be freely opened up and a catheter tied into the bladder (see p. 342). Healing usually occurs readily.

When an enlarged prostate is present, the treatment of acute prostatitis and prostatic abscess is sometimes very difficult. In all cases a soft rubber catheter must be tied into the bladder, as retention always complicates the affection, and of course aggravates it.

CHRONIC PROSTATITIS.

This condition usually follows an acute attack or is a sequel of gonorrhœa, the gonococcus finding its way into the glandular follicles. It may also be due to the use of unduly strong urethral injections or to excessive coitus. There is considerable enlargement of the prostate from interstitial inflammatory exudation, and this may lead to permanent enlargement of the organ if it lasts for any time.

The *symptoms* are a sense of weight and discomfort in the perineum, with frequent and sometimes painful micturition, whilst the urine contains filamentous threads formed by the secretion from the prostate. There may be a gleet discharge—especially noticeable in the morning—and occasional spasm of the perineal muscles, followed by the escape of a slightly opalescent fluid. *Per rectum*, the prostate is enlarged and tender on firm pressure, and there is usually some pain on defæcation. An examination of the urine and of the secretion expressed by massage of the prostate should always be made in order to determine the nature of the micro-organism present. The affection is very rebellious to treatment, and frequently produces much mental depression.

TREATMENT.—In the early stages, entire abstinence from alcohol and sexual excitement must be enforced. The patient need not be confined to bed, but bicycling or riding—or indeed anything which entails perineal pressure—should be forbidden, and the patient should lie down as much as possible. A light non-stimulating diet should be prescribed; the bowels must be kept freely open by saline aperients, and, if there is frequency of micturition, a mixture containing an alkali in combination with tincture of hyoscyamus and infusion of buchu, will be useful. Sedatives are rarely called for. In the more chronic cases, if they are not gonorrhœal in origin, sexual intercourse need not be forbidden.

In the local treatment, hot sitz baths are valuable. In obstinate cases, counter-irritation by the application of iodine or blisters to the perineum is useful. In all cases, any exciting cause must be sought for, and if possible removed. If the condition follows gonorrhœa, topical applications—such as solutions of nitrate of silver (five grains to the ounce)—to the prostatic urethra should be made through a urethroscope, and repeated at intervals of three to seven days, the strength of the solution being gradually increased. If too strong applications are used in the early stage, an acute inflammation may be set up. The urethra should also be irrigated with large quantities of permanganate of potash. This subject is dealt with more fully in connection with the treatment of gonorrhœa and gleet (see Chap. XXXV.).

Massage of the prostate from the rectum is very useful; its object is to empty the follicles. The patient should be placed in the knee-elbow position, the forefinger introduced into the rectum, and gentle pressure

made on the prostate in the downward direction; after two or three sittings, the pressure may be increased. At first the massage may be done every second or third day, and finally daily.

In long-standing cases, tonics—such as iron and nux vomica—should be given in combination with ergot (℥x-℥xx of the liquid extract, three times a day); sea-bathing or a sea voyage are often useful in young men who have had gleet for a prolonged period and are much run down in health and spirits. It is well to pass a full-sized, well-warmed bougie every third day; this dilates the prostatic urethra, and squeezes out superficial collections of mucus from the orifice of the glands. In all these cases, the vesiculæ seminales should be examined *per rectum*, because if they are inflamed, the prostatic condition will not get well until the vesiculitis has been cured (see Chap. XL.). Vaccines prepared from the organisms present may be employed.

Gouty prostatitis.—Prostatic irritation may be connected with gout. The attack generally occurs at night, and there is urgent painful micturition, the urine being very acid and depositing urates and mucus in large quantities. The prostate is very sensitive for a time, and retention of urine may occur. The treatment is mainly that for the milder forms of acute prostatitis combined with the administration of drugs suitable for gout, and the affection readily subsides.

CHAPTER XXXVIII.

CALCULI, TUMOURS, AND TUBERCULOSIS OF THE PROSTATE.

CALCULI.

PROSTATIC concretions usually form in the dilated follicles of the gland, especially when the organ is enlarged. They consist in the early stage of inspissated secretion. Phosphate or carbonate of lime is deposited on these concretions and forms calculi. Prostatic calculi are brown in colour, comparatively small, often faceted, and of a porcelain-like consistency. They can usually be shown by the X-rays.

Vesical calculi that have escaped from the bladder and have become embedded in the prostate, or that lie in the prostatic urethra and increase in size there, must be distinguished from true prostatic calculi. They are diagnosed after removal by the fact that their nucleus consists of oxalates, urates, or uric acid, whereas the true prostatic stones do not show these salts; calculi of vesical origin often project also into the bladder and become elongated and hour-glass in shape.

Prostatic concretions seldom give rise to severe *symptoms*; sometimes, however, they cause symptoms very similar to those of enlarged prostate. They are generally detected either on rectal examination or on passing a sound, by which the rough, characteristic grating of a calculus is detected before the beak of the instrument has reached the bladder. When the finger is introduced into the rectum, the stones, which are nearly always multiple, may be felt between the sound and the finger.

TREATMENT.—In the majority of cases, a median perineal section (see p. 348) should be made, the membranous urethra opened, the finger introduced into the prostatic portion, the mucous membrane divided, and the calculi removed with forceps or a scoop. A drainage tube should be inserted into the bladder from the perineal wound for a few days. When the calculi are large, a crescentic incision similar to that for the opening of a prostatic abscess is better, and the stones may then be removed by the extra-urethral method, as in operating for tuberculous disease of the prostate (see p. 407).

TUMOURS.

CYSTS.

Cysts due to dilatation of the glandular follicles are not uncommon. They are present in many cases of enlarged prostate, but as a rule they give rise to no symptoms. When they are so large as to project into the bladder, they are generally mistaken for an enlarged prostate or an adenoma of the gland.

Echinococcus cysts are sometimes met with in the prostate, but the majority of the hydatid cysts in this region arise in the cellular tissue between the prostate and the rectum.

TREATMENT.—If a cyst gives rise to symptoms and can be diagnosed, it should be opened and enucleated either through a perineal incision when it is situated on the lower aspect of the organ, or through a supra-pubic cystotomy when it projects into the bladder cavity.

When an *echinococcus* cyst is low down and comparatively small, an attempt should be made to reach it from the perineum by a transverse curved incision in front of the anus. Free drainage must be provided through the perineal wound, because septic infection can hardly be avoided. When the cyst is larger and projects upwards towards the anterior abdominal wall, it will be better to perform laparotomy, and then, after fixing the cyst to the abdominal wall, to open and drain it. These cysts should never be opened from the rectum.

CANCER.

Cancer of the prostate is not uncommon, and is usually of the columnar-celled type. It is characterised by enlargement and fixation of the gland, which feels hard and nodular on rectal examination; excessive pain is a very common symptom even in the early stages, and much bleeding may occur when the tumour ulcerates. If a prostate is hard, fixed, and very painful—even if only slightly enlarged—malignant disease should always be suspected. Micturition is often extremely painful and generally difficult. It should be noted, however, that a patient may empty his bladder completely even when there is a large mass of new growth.

Microscopic examination of prostates which have been enucleated for simple enlargement not infrequently shows the presence of malignant disease. Hence a guarded prognosis should always be given in cases of enlarged prostate until such examination has been made. Malignant prostates are more adherent and do not shell out so easily as the ordinary enlarged glands do.

TREATMENT.—When the diagnosis is clear, radical treatment should not be recommended. When the disease is at all extensive, it is practically impossible to remove it, and attempts to do so only tear up the growth and leave a ragged, raw surface, which extends rapidly and soon causes obstruction to the passage of urine with more pain than before. When there is a doubt as to the nature of the prostatic enlargement, it is better to wait and watch the progress of the case. If it should prove that the enlargement is innocent, no harm will have been done, and, considering the unsatisfactory results of operation of malignant disease, the patient will have been saved much distress and disappointment. As a palliative measure, the best plan is to establish supra-pubic drainage. Treatment by X-rays and radium, applied *per rectum* or through a perineal incision, may be tried.

TUBERCULOUS DISEASE.

Tuberculosis of the prostate is rarely primary; it is more often secondary to similar disease elsewhere in the genito-urinary tract, especially in the epididymis. The disease leads to irregular enlargement of the lateral lobes of the organ, and the tuberculous masses undergo caseation, and either become encapsuled and calcareous or break down and form abscesses.

When the urethral mucous membrane is implicated, the patient usually complains of dull aching in the perineum, increased by defæcation or exertion. Micturition is painful and frequent, and the last drops of urine are often blood-stained. The pain is referred to the tip of the penis or the neck of the bladder, and is most marked at the end of micturition. Retention may occur from swelling in and around the prostatic urethra.

If the urethral mucous membrane is unaffected, there may be few *symptoms* beyond a sense of fullness or uneasiness in the perineum combined with slight discomfort on defæcation when the bowels are at all confined.

On digital rectal examination, the prostate, instead of being smooth and elastic, is found to contain a number of nodules of varying size, and is often very tender. These nodules vary in consistency, and tend to soften, and fluctuation may be detected. When this is the case, there may be retention of urine and much pain on micturition.

When an abscess forms in connection with a tuberculous prostate, it not infrequently bursts into the urethra, leaving a ragged ulcerating cavity into which urine makes its way. At other times, abscesses situated in the posterior part of the prostate may open into the rectum, and an opening may also form in the urethra, thus leading to the formation of a recto-urethral fistula. The abscess may also burrow down into the

perineum and lead to sinuses, which usually end in urinary fistulæ. The condition is very serious and very difficult to treat.

TREATMENT.—In the early stages, the treatment may be palliative. Rest, good hygiene, and the avoidance of sexual excitement, combined with a general tonic treatment, are the main points. The use of instruments should be avoided, as they only irritate the prostatic urethra. When there is an obvious source of infection, as in the epididymis or in the kidney, these tuberculous foci should be removed if possible. This may lead to the cure of the affection, or at least may give relief.

When it is obvious that palliative treatment is not succeeding and that suppuration is occurring, the serious risks of allowing the abscess to burst into the rectum must be avoided by evacuating the pus through a perineal incision. In these cases, the median incision already described for acute abscesses will not suffice, as there may be considerable difficulty in reaching the small scattered foci, and a curved incision with its convexity forwards just in front of the anus is the best. A sound is passed into the bladder so as to define the urethra, and the latter is pulled forwards and the rectum backwards as the wound is deepened, until the levator ani is divided. If the abscess is of any size, it is usually detected at this stage, and the finger passes into a ragged cavity containing pus, which should be scraped out as thoroughly as possible—great care, however, being taken not to scrape through the wall of the urethra or the bladder; after this has been done, the cavity is packed with iodoformed gauze. A catheter should be tied into the bladder for a week or ten days, and the packing renewed at the end of the second day and subsequently daily for the same length of time. Afterwards, a soft catheter should be passed each time the patient desires to micturate until the wound has healed. Even if all the cheesy material has been scraped out, a sinus may remain for some time, and it may be necessary to open up the wound again and scrape it out.

In very obstinate cases of perineal urinary fistula due to this cause, a supra-pubic cystotomy may be performed with advantage so as to stop the flow of urine over the cavity. Excision of the prostate would only be justifiable if the affection could be attacked sufficiently early to enable the whole focus of disease to be removed, and if there were no tuberculous disease elsewhere. Theoretically, of course, this measure is the proper procedure, and it can be fairly easily done through a curved perineal incision. In practice, however, the surgeon will seldom be sufficiently sure that the disease is primary in the prostate to justify operative procedures that would be of little avail if the disease were secondary to genito-urinary tuberculosis elsewhere.

When the abscess has burst into the rectum, a perineal incision should be avoided, because a rectal fistula would be almost certain to result. It is better to dilate the anus, enlarge the opening of the abscess into the rectum, and scrape out the cheesy material.

CHAPTER XXXIX.

SIMPLE ENLARGEMENT OF THE PROSTATE.

SIMPLE enlargement of the prostate is common in patients over fifty-five; it is seldom seen before fifty, and comparatively rarely commences after seventy. Apparently, a considerable number of men over fifty-five are the subjects of the affection, although a comparatively small proportion have symptoms. Simple enlargement of the organ does not necessarily give rise to any symptoms beyond some increase in frequency of micturition, unless the enlargement is irregular in shape, very marked, or in some way interferes with the proper emptying of the bladder.

The weight of the prostate may be increased from the normal (about half an ounce) to several ounces. The nature of the enlargement varies; in some cases, there is general overgrowth of the fibrous elements and of the glandular tissue. In other cases, the enlargement is local and gives rise to definite tumours of the gland; this condition may involve a part or the whole of one lobe, and is frequently spoken of as adenoma of the prostate. The term adenoma is hardly correct, as the enlargements are rarely as completely encapsuled as a true adenoma is; they are more in the nature of lobular outgrowths from the main body of the prostate to which they are connected by a pedicle. This particular form is the common cause of the so-called enlargement of the middle lobe. The prostatic enlargement is as a rule irregular and may lead to great distortion of the urethra. There is always increase in length of the prostatic urethra, and it is flattened from side to side; as the prostate enlarges, it pushes its way upwards towards the bladder cavity inside the sphincter vesicæ. In some cases, the prostate is only slightly increased in size, and is firm, smooth, and rounded, forming a ring or collar around the neck of the bladder; to this form, the name 'fibrous enlargement' is applied. It is not very common, but it is a very important condition, as the effects are severe, and the operation for its removal is often very difficult, and the organ has to be removed piecemeal. Practically nothing is known concerning the etiology of simple enlargement of the prostate.

Various important structural changes may occur in the urinary

organs secondary to this affection; their nature and degree depend on the amount of obstruction and the length of time that it has lasted. The enlargement of the prostate causes difficulty in evacuating the bladder, and the muscular wall of the organ becomes hypertrophied in order to overcome this. The cavity of the bladder may remain of normal size or becomes larger than usual, whilst the muscular bundles are much hypertrophied, and the condition known as 'fasciculated bladder' occurs. In this form the hypertrophied muscular bundles stand out prominently on the surface of the bladder, and between them the mucous membrane is markedly depressed. If the obstruction continues, the mucous membrane in these depressions tends to be forced outwards, and form sacculi, which project from the outer surface of the bladder and communicate with its interior by comparatively small orifices between the muscular bundles—'sacculated bladder.' These are of importance because they may be large and a stone may form in them; they are lined with mucous membrane, and the submucous tissue is generally considerably thickened. If the obstruction continues unrelieved, the hypertrophy of the bladder ultimately gives way to atrophy and dilatation, so that the organ becomes much distended and thinned, and its surface is smooth and without many fasciculi, although sacculi that have already formed may remain. In advanced cases there may be ulceration of the mucous membrane.

If the backward pressure persists, its effects rarely remain limited to the bladder. The ureters dilate, their valvular openings become insufficient, and there is consequent dilatation of the pelvis of the kidney, and a certain amount of hydronephrosis. This may lead to polyuria and nephritis. The pressure also tends to obliterate or flatten the ejaculatory ducts. Sexual desire is more or less lost in the advanced stages, although it may be exaggerated at an early period.

The *symptoms* vary with the degree and nature of the enlargement. Sometimes a prostate which is felt *per rectum* to be very large may give rise to no appreciable symptoms, whilst, on the other hand, there may be very severe trouble, even though the organ hardly seems to be enlarged at all. One of the earliest symptoms is increased frequency of micturition; but this often passes unnoticed, unless it happens to disturb the patient at night, and even then there may be no frequency during the day. It will, however, usually be found on inquiry that the daily frequency is as great as or even more marked than that during the night. A more prominent symptom is an urgent desire to pass water, which cannot be resisted by an effort of the will; moreover, the stream cannot be stopped during the act of micturition. The patient generally notices that urine does not flow immediately he attempts to pass water, and that there is a diminution in the power of projection; after a time, the stream drops vertically downwards. Micturition takes unduly long, and urine is apt to escape after the patient thinks the act has been completed.

These symptoms increase as time goes on, and the nocturnal frequency becomes so great as to interfere seriously with the patient's sleep. There is not only difficulty in passing water, but there is severe straining in the effort to overcome the obstruction, and this may lead to hæmorrhoids, rectal tenesmus, or prolapse. As the bladder walls begin to atrophy, there is still more delay before micturition can be commenced, and after the act the patient constantly experiences a sensation that he has incompletely emptied his bladder; this is probably due to the fact that there is a considerable amount of residual urine in the post-prostatic pouch. There is no constant or severe pain as long as there is no cystitis.

The examination is made partly *per rectum* and partly by instruments passed *per urethram*. The finger in the rectum will note the undue size of the organ and any irregularity in outline or consistence; sometimes the prostate is so large that it may be felt bi-manually. By the use of a catheter, the length and direction of the prostatic urethra can be determined. The ordinary gum-elastic catheter moulded to the usual curve for the introduction of instruments into the bladder will not pass readily, because the urethral canal is distorted and elongated. The curve of the instrument should therefore be much increased, and the catheter should be an inch or an inch and a half longer than those in ordinary use, and should be furnished with a stylet to which the necessary bold curve can be imparted. The cystoscope may also be employed and by it the projection of the prostate into the bladder may be seen, and evidence obtained as to whether the whole or only part of the gland is affected.

A very important point to make out in examining any case is the amount of residual urine present, as this largely influences the line of treatment to be adopted. The patient is made to empty his bladder as completely as possible, and a catheter is then passed immediately, and any urine left behind drawn off and measured. This is the 'residual urine,' which may vary from a dram or two up to several ounces. The character of the urine must also be taken into account, and the bladder should be sounded in order to ascertain whether a stone is present or not.

Complications.—*Retention of urine* generally occurs in advanced cases, but it may also be met with at a comparatively early period, and indeed it may be the first symptom to attract the patient's attention to his trouble. In the early stage, it is probably due to congestion of the mucous membrane about the vesical orifice, and this may be caused by chills, over-feeding, or excess of alcohol; in advanced cases, it occurs from the continuous growth of the enlarged prostate, and is especially likely to arise when the prostate projects upwards and backwards into the bladder, forming the so-called enlargement of the middle lobe, which acts as a ball-valve over the urethral orifice. In these cases it often happens that after the patient has commenced to pass urine,

the stream may suddenly stop, owing to the enlarged lobe falling over the orifice of the urethra. In other cases, again, difficulty in micturition gradually increases until ultimately there is complete retention, and this is partly due to the increasing size of the prostate and partly to the atrophy of the bladder walls; under these circumstances, 'false incontinence' of urine may occur—that is to say, retention with overflow.

One of the most serious complications of prostatic enlargement is *cystitis*. A patient very seldom goes on to the end without the occurrence of cystitis. This is most commonly due to infection of the bladder in connection with the passage of instruments, but in some cases infection occurs even though no instruments have been used. In a healthy bladder, the introduction of a few micro-organisms along with an instrument seldom does harm unless the bacteria are very virulent, as they are simply washed out again; in cases of enlarged prostate, however, with much residual urine and an unhealthy condition of the bladder walls, a single introduction of an imperfectly sterilised catheter will almost certainly lead to decomposition of the urine and cystitis. The gravity of this affection depends largely upon the nature of the organism which gives rise to it; the most common is the colon bacillus. When the pyogenic organisms gain entrance, they may cause a very severe form of cystitis.

Calculi, usually phosphatic, may form in the post-prostatic pouch, and are a common and troublesome complication.

Hæmaturia is not uncommon in advanced cases, even when no instrument has been passed. When the amount of blood is small, it mixes with the urine and is passed without causing any trouble; when, however, there is much hæmorrhage, the blood may find its way into the bladder, where it clots and causes great distress.

Other complications are *urethritis* and *epididymitis*, which depend—to some extent, at any rate—upon injuries caused by instruments after the commencement of 'catheter-life.' Urethritis, especially, is a very serious complication, as it renders the passage of a catheter painful and adds largely to the patient's sufferings. *Prostatitis* and *prostatic abscess* may also occur, and may be followed by *urinary infiltration*.

We would here also point out that it is not very uncommon for *carcinoma* to be found in an enlarged prostate, and hence a microscopical examination should be made in every case after removal of the gland.

TREATMENT.—This may be palliative or operative; the former consists of various hygienic measures, the administration of drugs, and the use of catheters, whilst the latter aims at removing the obstruction.

Choice of methods.—The determination as to whether any given case should be treated by palliative or operative measures is sometimes very difficult. In quite the early stages, when the symptoms are slight and intermittent, operative interference may quite well be deferred. When, on the other hand, the patient's life is a burden to him, and he suffers

from pain, restlessness, and sleeplessness, and when ordinary palliative measures have failed, the question of radical treatment becomes urgent. While there is no difficulty in deciding in favour of operation in these extreme cases, it is better not to delay it until the condition of the patient has become so unfavourable. When the difficulties in micturition are increasing, and when the time is approaching when catheterisation becomes necessary, operation should be advised while the patient's general condition is good. It should also be urged if there have been attacks of retention, if catheterisation is painful or difficult, or if cystitis has occurred. The urine should, however, always be carefully examined before advising operation—especially as regards the question of renal inadequacy; the specific gravity, the percentage of urea, and the quantity of urine passed in twenty-four hours should be ascertained.

Palliative.—**In the earliest stage**, the enlarged prostate is generally congested, and anything that may increase this condition should be avoided. The diet should be light and non-stimulating, the meals should be regular, and alcohol should be avoided—at most, some light wine may be permitted; the quantity of fluid taken should be diminished as much as possible without causing concentration of the urine and consequent irritation. No food should be taken for two or three hours before bedtime, and the bowels should be regulated. Exposure to cold and excessive bodily exercise must be avoided. The bladder must not be allowed to become distended, and the patient should not attempt to hold his water, as the troublesome symptoms frequently date from some occasion upon which retention has occurred from want of opportunity of emptying the bladder when it was necessary. The bladder should be emptied regularly at short intervals, and the act should always be performed in the standing position, as the bladder is thus more completely evacuated.

Drugs are of little value in reducing the size of the prostate, although ergot is sometimes given. When there is irritability of the bladder, the ordinary vesical sedatives—such as tincture of hyoscyamus in half-dram doses—may be used. If there is decomposition of the urine, urinary antiseptics (see p. 446) should be employed; when it is due to the bacillus coli, vaccines may lead to improvement. Many patients derive benefit from a visit to a health-resort—such as Wildbad, Marienbad, or Vichy. Other methods—such as the application of nitrate of silver to the prostatic urethra, injections into the gland, massage, electricity, and mechanical pressure exerted by passing large instruments—have been recommended, but are of little value. Possibly, some good may be derived from the use of X-rays and high-frequency currents.

In the second stage—the period marked by definite 'residual urine,' but without cystitis—the bladder should be periodically emptied by a catheter, as the presence of residual urine tends to increase the congestion and is a constant source of danger. The regular withdrawal of residual

urine diminishes the congestion of the prostate, but at the same time the employment of an instrument exposes the patient to a certain amount of risk. The following rules may be of use: If the residual urine amounts to about three ounces, the catheter should be passed once daily; if it reaches six ounces, the catheter should be passed twice a day, and once extra daily for every two ounces above this quantity. Should there be complete retention, the instrument should be used at regular intervals—every three or four hours. The catheter should in any case be passed immediately before the patient goes to bed, so as to empty the bladder and ensure some hours' sleep.

When the urine is aseptic, there is no need to irrigate the bladder in addition to evacuating it; should cystitis occur, however, this will be necessary. The management of the case when cystitis is present is referred to below (see p. 414).

Catheters.—The best catheter for the purpose—especially when the patient passes it himself—is Jaques' red-rubber catheter, which can generally be passed fairly easily, and with which it is impossible for the patient to injure himself; it also has the great advantage that it is easily disinfected, and is not spoilt by boiling. A No. 8 English is the best size, as it is too large to get caught in the folds of the urethra, and too small to do any damage.

When the urethra is so distorted that the red-rubber instrument fails to pass, the black coudée or bicoudée catheter (see Fig. 111) is very useful. Gum-elastic catheters are much employed in England; they are moulded on a stylet to a proper curve, and may be bent to any shape after immersion in hot water, and they retain the curve imparted to them when allowed to cool. They are very easy for the surgeon to pass, but they are difficult for the patient himself to use. An excellent flexible catheter, both of the olivary and coudée type, is made by Porgés of Paris; and can be boiled repeatedly without deterioration. It is supplied by Messrs. Alfred Cox & Sons, of New Bond Street. Metal instruments should rarely be used, and not at all by an unskilled person, as they may cause serious damage; they should be an inch and a half to two inches longer than the usual instrument, and should have the bold prostatic curve. No. 8 or 9 is the best size.

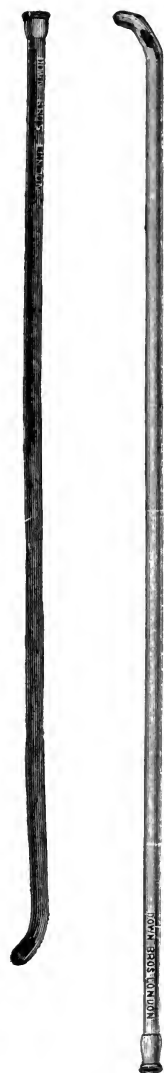


FIG. 111. — COUDÉE AND BICOUDÉE CATHETERS FOR USE IN CASES OF ENLARGEMENT OF THE PROSTATE.

Catheter fever.—Attacks of so-called ‘catheter fever’ may occur in any patient who has to use catheters. The attack is ushered in by shivering, accompanied by high temperature, which in ordinary cases lasts only a few hours and then passes off. This attack may, however, be followed by suppression of urine or septic troubles in the kidney. The exact pathology of catheter fever is uncertain. By some it is held to be always due to a septic infection, but this can hardly be the case, as the rigor may follow the passage of a catheter within a few moments, and on this hypothesis it must be due to a toxin absorbed through some scratch in the prostatic urethra, since there would not be time for any bacterial development in the body before the onset of the symptoms. It is very unlikely, however, that a sufficient amount of toxin can be taken in on a catheter which has undergone even moderate cleansing. It would seem that true catheter fever is a reflex nervous phenomenon, and the suppression of urine occurring in connection with it must also be reflex. Should the catheter fever be complicated by sepsis, the original mischief goes on to a more serious septic condition. In order to avoid the occurrence of this complication, the instrument should be passed only in the patient’s own house in the first instance, and if he be elderly, he should be kept in bed for some hours before the catheterisation.

The treatment of an attack of catheter fever is to administer stimulants and apply hot bottles until the attack has passed off. When there is a history of these attacks after passing instruments, it is well to give a dose of 5 to 10 grains of quinine an hour or two before the catheter has to be passed, and to take special precautions to guard the patient from exposure during the proceeding. As a rule, the tendency becomes less as time goes on, and the patient may ultimately pass the catheter without any trouble.

Of complications.—The treatment of *cystitis* must follow the lines laid down for that affection in Chap. XLIII. When it occurs in the early stages of the disease, local measures should be avoided as far as possible, and the various general treatment recommended on p. 445 should be employed. Should the cystitis continue and become chronic, however, local treatment will be necessary. In the first instance irrigation of the bladder (see p. 447) is important; instillations (see p. 449) may also be called for, provided that they do not set up irritation. In worse cases, continuous drainage (see p. 447) may be necessary. In very bad cases, it may be necessary to open and drain the bladder—preferably above the pubes—should the patient be unable to stand a radical operation or should he refuse it. In all these cases, a culture may be made of the organisms present in the urine, and a suitable vaccine prepared and administered. The colon bacillus, or an organism belonging to that group, is very frequently found.

Retention of urine should be treated on the lines detailed in Chap. XXXVI.; but there are certain special points to be attended to in

these cases. In the first place, the bladder should not be suddenly emptied of all the urine. The urine should be withdrawn slowly while the patient is in bed in the recumbent position. If there is great distension of the bladder, it is advisable to tie in a No. 5 or 6 catheter and allow the water to dribble away. Sudden emptying of the bladder may not only cause faintness, but may also lead to hæmorrhage into its cavity; and sometimes after a rapid evacuation, the kidneys cease to excrete urine, and the patient passes into a uræmic state and dies. Special care must also be exercised to prevent infection, as, owing to the obstruction to the outflow of the urine, the bladder is not easily emptied by the natural expulsive act. Further, the mucous membrane of the bladder is not healthy, and therefore bacteria may establish themselves in it more easily than in a normal organ.

Epididymitis is not uncommon, and, with the view of avoiding it, patients who are the subjects of prostatic enlargement should wear a suspensory bandage, and the greatest possible care should be taken in securing asepsis of the instruments. The treatment is similar to that of epididymitis from other causes, and is described on p. 293. It has been suggested that, when there are frequently recurring attacks of epididymitis, vasectomy should be performed—not only on account of its effect upon the prostate, but also in order to cut off direct communication between the testis and the urethra. In these cases, however, the question of prostatectomy should be considered, and if it is unadvisable, owing to the general state of the patient, it may be necessary to establish supra-pubic drainage, which may also be necessary when the urethra has become so irritable that catheters cannot be used, when the obstruction is so great that no instrument can be passed, or when severe cystitis is present, provided always that prostatectomy cannot be performed. The operation is the same as that for supra-pubic cystotomy; the mucous membrane of the bladder is stitched to the skin and, when healing is complete, a permanent drainage tube is arranged. Witzel has suggested that the opening should be made into the bladder on the principle of his operation for gastrostomy, the catheter being introduced when required, and removed in the interval; the valvular opening will then prevent leakage.

For free *hæmaturia*, the best procedure is to introduce a large catheter in the first instance and tie it in, in the hope that its pressure will arrest the bleeding. When, however, there is much clot in the bladder, the eye of the catheter will get blocked, and the clots must be removed as soon as possible, as not only will they lead to acute retention, but decomposition, followed by very serious cystitis, will occur. As a rule, this may be done by attaching an evacuating apparatus (Fig. 126) to the catheter and sucking the clots up through the tube. Drugs given internally—except possibly ergotinine citrate (gr. $\frac{1}{100}$) administered hypodermically—seem to have no effect on the bleeding. When the hæmorrhage is severe,

the bladder should be opened above the pubes, the clots removed, and the cavity irrigated with sterilised salt solution at a temperature of 110° to 115°F . Spinal anæsthesia should be employed in these cases in preference to a general anæsthetic, and removal of the prostate should be proceeded with at once, if the patient's condition permits; if not, as soon as possible afterwards.

Another important complication is the presence of phosphatic *calculi* in the post-prostatic pouch. These are usually associated with cystitis, and cause a great deal of trouble to the patient. Litholopaxy is not suitable for these cases, and supra-pubic cystotomy should therefore be performed. Not only are the stones immediately and completely removed by this operation, but the septic condition of the urine will rapidly improve with the drainage of the bladder, and, further, there is no longer any residual urine, and therefore no likelihood of fresh deposit of phosphates. The prostate may be enucleated at the same time, or, still better, later on, when the septic condition of the urine has diminished.

Radical.—Prostatectomy.—This operation is now performed quite early in the course of the disease, and especially when it becomes necessary to resort to the use of catheters. Its advantages are that the risk of complications is prevented, the cause of the obstruction is removed, the patient is able to micturate naturally, and, instead of having to pass a catheter frequently or to empty his bladder constantly, can retain his urine for several hours. His general health improves greatly after the operation. The mortality after prostatectomy is remarkably low when it is borne in mind that the majority of the patients are old and feeble.

Anatomy of the prostate.—The prostate consists of two lateral lobes, which are enveloped in a common capsule formed from the peripheral portions of the gland. The lateral lobes are united to one another in front of and behind the urethra by the anterior and posterior commissures of the gland. The term middle lobe, in the strict anatomical sense, is applied to that portion of the gland which lies between the common ejaculatory ducts and the urethra.

The upper surface or base of the gland is directed towards the bladder; the posterior surface is in front of the anterior wall of the rectum, from which it is separated by a thin layer of pelvic fascia; the apex is directed downwards and is in relation with the compressor urethræ; the lateral surfaces lie in contact with the fascia covering the upper surface of the levator ani muscles. The urethra passes through the gland in a curved direction and somewhat nearer the posterior than the anterior surface. The common ejaculatory ducts run downwards, inwards, and forwards through the substance of the gland to enter the prostatic urethra, one on each side of the sinus pularis. The whole gland is enclosed in a layer of fibrous tissue derived from the pelvic fascia, and in this sheath the prostatic

plexus of veins is situated. Fibrous bands pass between the sheath and the true capsule of the gland; it is the separation of these two layers which allows the prostate to be enucleated.

The prostate may be removed either from above, the bladder being opened above the pubes—supra-pubic prostatectomy—or from the perineum—perineal prostatectomy. In this country, the former method is the one most extensively employed, but on the Continent and in America, the perineal route is often used. The operation by the perineal route is perhaps more difficult than the other, but in skilled hands the mortality of the two operations is about the same, and the choice of the method must be determined on other grounds. When it is found on careful rectal examination that the prostate is markedly enlarged with a definite furrow in the median line between the two lobes, that the surface is smooth and the gland is movable, the case is one suitable for supra-pubic enucleation. Perineal prostatectomy is indicated when the enlargement is fibrous and the prostate is dense and hard. The size of the prostate and the amount of projection into the bladder may sometimes be estimated by a bi-manual examination with the bladder emptied. In thin subjects, and those in whom the abdominal muscles are easily relaxed, this method of examination is very useful, but in stout people and those with rigid muscles, it is difficult and uncertain. The degree of enlargement into the bladder does not necessarily correspond with the apparent size of the prostate as revealed by rectal examination alone. When the prostate is small—and quite a small amount of enlargement may cause severe obstructive symptoms—cystoscopic examination will reveal the amount of projection into the bladder.

Supra-pubic enucleation.—A general anæsthetic, or spinal analgesia with stovaine, may be employed. The latter is very suitable for feeble patients with bronchitis or renal complications, and for those who are corpulent and in whom perfect muscular relaxation is essential.

A soft black catheter is first introduced *per urethram*, and the bladder washed out with sterilised normal saline solution, and then filled with a fresh quantity of the same liquid. The amount left in the bladder will depend on the capacity of the organ, but it should be sufficient to make the distended bladder easily palpable above the pubes. The first step of the operation is to perform a supra-pubic cystotomy in the manner described on p. 474. The incision in the bladder wall may be made longitudinally or transversely, and must be long enough to allow the finger to be easily inserted. The edges of the wound in the bladder are held up by a stitch on each side, which is inserted before the incision into the viscus is made, so as to prevent the bladder dropping back into the pelvis as the urine escapes. A finger is then introduced into it in order to determine the presence or absence of calculi and the size and amount of projection of the prostate. If calculi are present, they are removed by suitable forceps, and the bladder washed out.

If the urine is foul, it is better not to remove the prostate at once, but to insert a drainage tube and wait for a week or ten days until the renal function is in a more healthy condition. A large drainage tube is placed so that its end is just inside the bladder, and is fastened by stitches to the rectus muscle. Operation in two stages is also useful in very old and feeble people, and the small degree of shock and inflammatory reaction after the second operation is sometimes very remarkable.

The enucleation is carried out as follows, whether it is performed at the time the bladder is opened or some days afterwards. The most prominent part of the projecting lobe, or of the middle lobe if that is present, is selected as the point at which to begin; this intravesical projection of the prostate is only covered by mucous membrane, and lies inside the sphincter vesicæ. The surgeon places his left forefinger in the rectum so as to push the prostate forwards and steady it during the manipulations, while the right forefinger is introduced into the bladder, and the mucous membrane over the projecting part of the prostate just inside the sphincter vesicæ is either snipped through with a pair of scissors or torn through by the pressure of the finger-nail or a sharp director. When the capsule proper is reached, the finger is passed between the enlarged gland and the surrounding tissue, and the separation proceeded with all round until the apex of the gland and the urethra are reached. When the whole gland has been loosened in this way, the prostatic urethra is torn across as high up as possible. The prostate now lies free in its cavity, and is removed by means of the finger or suitable forceps either as a whole or in two halves.

If there is much hæmorrhage after the removal of the prostate, the cavity should be irrigated with sterile saline solution at 120° F. In the majority of cases this is unnecessary, and still more rarely is it necessary to pack the cavity with gauze strips. If that must be done, the strips should be removed at the end of forty-eight hours. A large drainage tube, with an internal diameter of three-quarters of an inch, should be introduced, so that its inner end projects into the bladder for about half an inch, and the outer end fastened to the skin with a silkworm-gut suture. A small drainage tube should be placed in the space behind the symphysis pubis in case infection should occur from the septic urine. The rest of the skin incision and the margins of the separated recti muscles may be approximated by through-and-through sutures; buried stitches should not be employed, as they are very apt to become infected and delay the healing of the wound.

The dressings should be abundant, and are changed as often as may be necessary. During the first twenty-four hours, some clots may be discharged through the tube or collect in it and in the bladder. The bladder should be irrigated with hot saline solution through the tube and the clots removed at least once a day. It is most important that

drainage should be free. The large tube may be removed about the fourth or fifth day and a smaller one substituted for a few days longer. About this time, an Irving's supra-pubic box (Fig. 112) may be substituted for the dressings. If this is properly applied and fits the patient, he should be absolutely dry. The box must be removed and cleaned at least twice daily. The skin should be smeared thickly with Lassar's paste, or 40 grs. of oxide of zinc to the ounce of lanolin, in order to prevent irritation.

After-treatment.—The patient should be kept recumbent for the first twelve hours after the operation and then placed in a sitting position. Shock following the operation is treated on the lines laid down in

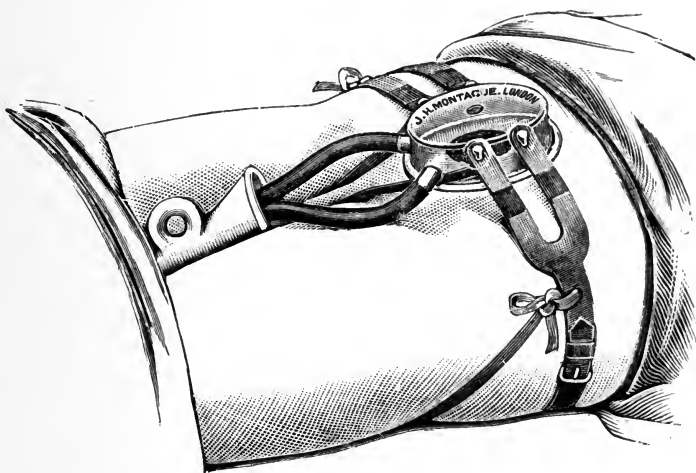


FIG. 112.—IRVING'S SUPRA-PUBIC DRAINAGE APPARATUS.

Vol. I. p. 117. Stimulants and saline solution may be given as required. If there is severe pain or restlessness, heroin (gr. $\frac{1}{12}$ to gr. $\frac{1}{8}$) or morphine (gr. $\frac{1}{8}$ to $\frac{1}{4}$) should be administered. At the end of the third day, a purgative should be given, and the bowels must subsequently be opened daily. Plenty of liquids are given for the first day or two, and light solid diet may be commenced after the bowels have been moved. It is not advisable to pass a catheter *per urethram* until ten or fourteen days have elapsed; any irrigation of the bladder which may be necessary should be carried out through the supra-pubic wound. As a rule, urine will begin to pass *per urethram* about the third week, after which the fistulous opening will soon close.

Complications.—*Hæmorrhage.*—This may continue for some days. If the irrigation with hot saline solution does not stop it, ergotinine citrate (gr. $\frac{1}{100}$, hypodermically) or calcium lactate (gr. x, every four hours) may be given. In a few cases, secondary hæmorrhage has occurred, and if

it is not arrested by irrigation with hot saline solution, the cavity from which the prostate was removed should be packed with gauze for thirty-six to forty-eight hours, and a large drainage tube re-inserted into the supra-pubic wound.

Cystitis.—The urine may become very foul from septic infection, and cystitis may set in. The bladder must be irrigated with a solution of boric acid or potassium permanganate, three or four times a day, and the usual internal remedies (see p. 446) given. Phosphatic calculi may form in the cavity from which the prostate has been removed; they must be extracted by forceps through the supra-pubic wound.

Epididymitis sometimes occurs. Usually, it undergoes resolution, but it may go on to suppuration, in which case the pus must be evacuated as soon as possible and the abscess cavity drained.

Failure of the supra-pubic wound to close.—This occurs in a certain proportion of cases. In others, there is considerable delay in the closure, or the wound may re-open after apparently healing. In these, a catheter may be passed into the bladder through the urethra and tied in for a few days; occasionally, it has been necessary to drain the bladder through a perineal incision. One of the causes of this complication is adhesion of the bladder to the back of the symphysis pubis, and in that case the wound should be re-opened, the bladder freed, and the opening in it sewn up with a double row of catgut sutures.

A stricture at the entrance of the urethra into the bladder may form and keep open the fistula, or a fold of mucous membrane may block the opening. It is advisable to pass a sound about the end of fourteen days to see that there is no such obstruction, and tie in a catheter through the urethra, if necessary.

Bronchitis and *hypostatic pneumonia* may also occur.

Perineal prostatectomy.—The patient is placed in the exaggerated lithotomy position, so that the perineum is directed upwards. A metal staff is inserted into the bladder and given to an assistant to hold, and an inverted V-shaped incision is made in the perineum. The point of the V lies just behind the bulb, whilst its extremities are midway between the anus and the tuber ischii on each side. The skin and subcutaneous tissues are divided, and the perineal raphe is exposed in the mid-line. This raphe, which contains some muscular fibres, is then divided transversely with scissors. The space between the rectum and the prostate is now opened up with the fingers, great care being taken not to injure the former, which is drawn backwards by a broad retractor. The smooth posterior surface of the prostate in its capsule is exposed, and the urethra is opened just behind the bulb. Through this urethral incision, Young's special tractor is introduced into the bladder, the blades widely opened, and traction made, thus bringing the prostate down into the wound. The capsule is cleared of fat, and an incision is made through it on each side of the mid-line, avoiding the large veins.

Through these incisions, the lateral lobes are shelled out by the finger ; care must be taken to avoid injury to the urethra, but it is not always possible to do so. Young advises that ' the incision on each side of the median line should be about 1.5 cm. deep, and be carried up over almost the entire length of the posterior surface of the prostate. The two lines are divergent, being about 1.8 cm. apart above and 1.5 cm. below. The bridge of tissue which lies between them contains the ejaculatory ducts, and its preservation is of importance if the integrity of these structures is to be maintained. It is for this purpose that the initial capsular incisions are made 1.5 cm. deep on each side, and these define at once and correctly the width of the ejaculatory bridge and prevent its being torn as might happen if blunt dissection alone were relied upon.'

After the prostate has been removed, a large, soft catheter is passed into the bladder through the wound and fixed in position by a stitch.



FIG. 113.—PROBE-POINTED GORGET.

Young uses a double-way catheter for continuous irrigation of the bladder for the first twenty-four to forty-eight hours, after which the catheter is removed. The cavity left after removal of the prostate is lightly packed with gauze, which is removed in forty-eight hours, fresh packing being introduced. The skin wound is partially closed by sutures ; the cavity heals by granulation. At first the urine is passed by the perineal wound. Permanent incontinence may follow if the neck of the bladder or the compressor urethræ are damaged. A fæcal fistula will follow if the rectum is injured ; great care must therefore be taken to avoid damaging the rectum by having it well retracted and the parts fully exposed before the enucleation is begun. If the rectum is injured, the rent should be carefully closed by a double row of catgut stitches. Hæmorrhage is often abundant. The operation is more difficult and takes longer than the supra-pubic method. Moreover, the after-results are probably not so good, so that we do not recommend it for the general run of cases.

For fibrous enlargement of the prostate, Pardoe recommends the following operation. A median-grooved staff is passed into the bladder, and the patient is placed in the lithotomy position. A small median perineal incision is made into the urethra immediately behind the bulb, and a gorget (see Fig. 113) passed along the groove of the staff into the bladder,

dilating the compressor urethræ and the prostatic urethra. The staff is withdrawn, and the right forefinger introduced along the gorget; very considerable force is often required to introduce the finger in these cases as the neck of the bladder is tightly contracted. The gorget is now withdrawn and the left forefinger is passed into the rectum. The mucous membrane on the floor of the prostatic urethra is split in a backward direction by the finger in the urethra working against the finger in the rectum, and the whole ring of the prostate is detached until the neck of the bladder is free and the finger passes in and out quite easily. As large a perineal drainage tube as the passage will take easily is stitched in, and the patient returned to bed. The tube is removed in two or three days, and the patient allowed to get up and move about freely. There is often incontinence for some days after the removal of the tube, but this soon ceases, and the patient can retain and void his urine spontaneously.

CHAPTER XL.

PROSTATORRHŒA : AFFECTIONS OF THE SEMINAL VESICLES.

PROSTATORRHŒA.

IN this condition there is a discharge of prostatic fluid accompanied by marked neurasthenic symptoms. In addition to the discharge of fluid, there may be other nervous symptoms, such as spasm of the sphincter vesicæ, with arrest of the flow of urine and some pain, great hyperæsthesia of the prostate, and a variety of abnormal sensations. The fluid that escapes from the urethra may be copious, and resembles white of egg, and its presence gives rise to profound mental depression in the case of a neurotic patient. There is generally some increased frequency of micturition and sexual irritability, and there may be a certain amount of chronic inflammation of the prostatic urethra ; a history of antecedent gonorrhœa or masturbation is not uncommon.

TREATMENT.—In the early stages, benefit may be obtained by passing the largest-sized bougies possible, which press out the secretion from the follicles, and empty them for the time being ; the same result may be obtained by pressure on the prostate from the rectum—‘ massage of the prostate.’ The urethra should be washed out, and topical applications, such as a strong solution of nitrate of silver, may be made to the mucous membrane through a urethroscopic tube. This subject is dealt with in connection with the treatment of gleet (see p. 359).

Tonics should be administered, and the patient’s attention diverted as much as possible from his condition, which he should be assured is in no way serious. Due regard must be paid to general hygiene, and the bowels must be regulated ; cold-water douches, shower-baths, and regular exercise are advisable. Sandal-wood oil in ten-minim doses three times a day after meals, belladonna, ergot, or strychnine, are valuable in different cases. If the patient suffers from nocturnal emissions, 20–30 grains of bromide of potassium administered about three hours before he goes to bed may check them. In bad cases, it is well to insist upon a rest-cure in a nursing home or a hospital, male nurses being in attendance.

AFFECTIONS OF THE VESICULÆ SEMINALES.

The only conditions requiring notice are inflammation and tuberculous disease of these organs.

VESICULITIS OR INFLAMMATION OF THE VESICULÆ SEMINALES.

This may be acute or chronic, and usually follows gonorrhœa. *The acute form* rarely goes on to suppuration, and usually accompanies prostatitis or other gonorrhœal complications. It gives rise to irritability of the bladder and pain in the region of the prostate and perineum; the finger in the rectum may detect the enlarged and tender vesiculæ.

Chronic vesiculitis is more serious on account of the extreme mental depression which it almost invariably excites in patients suffering from it. This condition is frequently present in connection with prostaticorrhœa, the vesiculæ, which are hard, swollen and tender, containing a considerable quantity of turbid material which escapes into the urethra.

TREATMENT.—The treatment of the *acute* affection is generally simple, as the mischief usually subsides when the acute condition which it accompanies passes off. The patient should rest in bed, plenty of fluid being given to drink; warm rectal injections are beneficial.

For *chronic vesiculitis*, general hygienic treatment and the administration of tonics should be adopted, but the main reliance must be placed on local treatment. One of the chief obstacles to recovery is the retention of the discharge in the vesicles, owing to the narrow exit and the difficulty in escape. A method of treatment, which he terms 'stripping the seminal vesicles,' has been introduced by Fuller, of New York. With the view of emptying the vesiculæ, the finger is introduced into the rectum—preferably with the bladder full—the bladder is pressed down from above the pubes, and pressure is applied to the vesiculæ seminales from behind forwards, so as to expel their contents into the urethra. This is done several times, until the vesiculæ are empty. Considerable irritation may follow the early attempts, and Fuller recommends that it should not be repeated oftener than once a week, or once a fortnight; but he says that, if this method is steadily carried out, the obscure local troubles of which the patient complains, gradually disappear, and with them the severe mental depression.

TUBERCULOSIS OF THE SEMINAL VESICLES.

This is rare as a primary condition, but is quite common as a secondary affection. It is nearly always present in tuberculous epididymitis, and frequently follows tuberculosis of the bladder and prostate. It is very chronic, and rarely results in suppuration. When an abscess does occur, it may burst into the rectum or the bladder, or it may make its way down behind the prostate and burst in the perineum. Tuberculous

peritonitis and tuberculous cystitis are apt to follow extension of the disease in this region, whilst the prostate almost invariably becomes involved.

TREATMENT.—The surgical treatment is limited to cases in which suppuration has occurred, although some surgeons have removed tuberculous vesiculæ seminales before suppuration has taken place. It is doubtful whether an operation of this kind should ever be performed, as it must be very extensive, and the affection is usually secondary, and therefore does not warrant it.

As soon as suppuration is evident in the neighbourhood of the vesiculæ seminales, a perineal incision should be made and the surgeon should gradually separate the tissues behind the prostate until the abscess is reached and evacuated by the perineum, thus avoiding the risk of its bursting into the rectum or the bladder. The procedure is similar to that for tuberculous disease of the prostate (see p. 407), except that the separation must be carried farther up between the prostate and the rectum until the abscess cavity is reached.

SECTION III.—AFFECTIONS OF THE BLADDER.

CHAPTER XLI.

CONGENITAL ABNORMALITIES OF THE BLADDER.

EXTROVERSION OR ECTOPIA VESICÆ.

IN this condition, the deformity varies from complete absence of the anterior wall of the bladder and the abdominal wall in front of it, together with wide separation of the pubic bones, to a small defect in the region of the neck of the bladder. In the male, complete epispadias and a rudimentary penis are usually associated with it, while in the female the urethra may also be split. It is apparently more frequent in the male than in the female; in the former, the testicles may be imperfectly descended, and congenital hernia is not uncommon.

In complete extroversion, the red, thickened mucous membrane of the posterior wall of the bladder protrudes beyond the level of the surface of the abdomen, showing the ureteral orifices at the lower part just behind the root of the penis. The urine undergoes ammoniacal decomposition, which leads to irritation and ulceration of the skin around, with deposition of phosphates; the exposed mucous membrane becomes inflamed and hypertrophied, bleeds readily, and is often papillomatous and ulcerated. The muscular coat of the bladder is very defective, so that practically nothing intervenes between the mucous membrane and the peritoneum but a little loose cellular tissue. Patients with extroversion may live for years, but death frequently occurs in early puberty from sepsis spreading up the ureters.

TREATMENT.—This may be either palliative or operative. *Palliative treatment* consists in the use of an apparatus, such as Irving's (see p. 419), fitted over the exposed bladder so as to conduct the urine into a urinal, and great care is necessary to keep the parts clean and prevent decomposition of the urine and the deposit of phosphates.

Unfortunately, owing to the deformity in the pelvis and urethra, it is almost impossible to get an apparatus that will effectually prevent the escape of the urine, and a certain amount of irritation always occurs.

The *operative measures* may be divided into two main groups: in the one, attempts are made to restore the anterior wall of the bladder; in the other, the urine is diverted by transplanting the ureters. The plastic operations on the bladder are accompanied by a distinctly lower mortality than transplantation of the ureters, but their results are not so satisfactory.

Plastic operations upon the bladder.—These operations only give an imperfect result even when they are successful in covering the surface of the bladder, because it is impossible to provide a fresh sphincter vesicæ which will enable the patient to retain his urine. Cases have been recorded in which as much as three or four ounces of urine could be retained in the cavity formed by the operation, but there is no control over it,

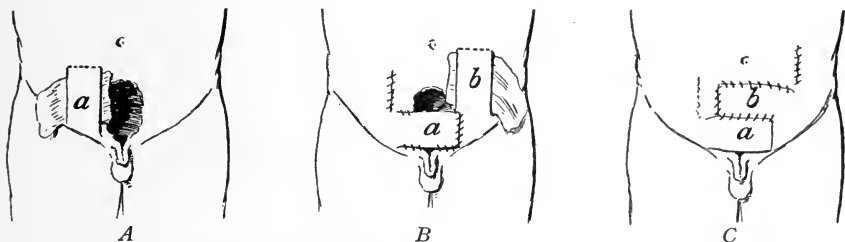


FIG. 114.—THIERSCH'S OPERATION FOR ECTOPIA VESICÆ. In *A* the first flap, *a*, has been shaped and left attached at both ends, with gauze interposed between its deep surface and the subcutaneous tissues. In *B*, it has been divided above and turned into place, and the second flap, *b*, cut in a similar manner. In *C*, this flap has also been secured in place.

and it is always liable to escape involuntarily. Nevertheless, a successful operation of this kind is of value because it protects the mucous membrane from irritation and relieves the patient's suffering very much, whilst it also enables a well-fitting urinal to be worn and thus increases his comfort. These operations should be done as early as possible—from two years of age upwards.

The plastic operations are of two kinds: In one variety, flaps are made from the skin; in the other, the bladder is reconstructed by suture of its own mucous membrane. Of the 'cutaneous' operations the best is that introduced by Thiersch; these operations are very rarely done at the present time, as the results are so very unsatisfactory.

Thiersch's operation.—In this procedure the bladder is covered by flaps of skin and fascia turned in from the side of the abdomen; the difficulty is the occurrence of sloughing in the flaps, which must necessarily be long. Thiersch has attempted to overcome this difficulty by cutting a flap of requisite size, undermining it, and leaving it attached at both ends for some days until complete granulation of the raw surface

has taken place (see Vol. I. p. 160); one end is then detached and the flap turned into place. When this has united, a second flap is formed in the same manner, and, if necessary, still another, until the anterior surface of the bladder is covered in (see Fig. 114); finally, the epispadias



FIG. 115.—PLASTIC OPERATION FOR ECTOPIA VESICÆ. *First stage.* A catheter has been passed into each ureter and the bladder wall dissected away from the peritoneum and retro-peritoneal tissues. This is done until about half of the bladder is freed, as shown in the figure. The peritoneum is then opened along a line which corresponds to the base of the flap at the stage shown in the figure. The patient was a female child.

is repaired. Several cases operated upon by this method have given fairly satisfactory results, but of course a urinal has to be worn constantly.

In the other type of plastic operation the edges of the bladder are dissected up and sutured together. In *Segond's operation*, the upper part of the mucous membrane and submucous tissue is turned down and stitched to the lower edge, which has been also detached and turned up

for a little distance, and the raw surfaces are covered in by flaps taken from the abdominal wall and the prepuce.

In *Trendelenburg's operation*, the sides of the bladder are approximated by dividing the posterior sacro-iliac ligaments on each side and approximating the ends of the pubic bones; this operation is only applicable to very young children before ossification is advanced. The main points of the operation are as follows: The patient is turned over almost on to the face, and an incision is made over one sacro-iliac



FIG. 116.—PLASTIC OPERATION FOR ECTOPIA VESICÆ. *Second stage.* The contents of the peritoneal cavity are packed out of the way with gauze, and a finger is introduced into the peritoneal cavity so as to protect the ureter, which is apparent owing to the presence of the catheter in its lumen. The whole of the bladder wall is then detached with scissors.

synchondrosis, the joint exposed, and the posterior ligaments divided as freely as possible. While this is being done, an assistant makes firm pressure over the crest of the ilium on each side, so as to keep the parts on the stretch and facilitate the detection of undivided bands. When one joint has been thoroughly opened up, a similar procedure is carried out on the opposite side, until both innominate bones can be pushed inwards sufficiently to allow the pubic bones almost to touch in the middle line. The posterior wounds are then closed, and an interval of some days is allowed to elapse before proceeding to the second part

of the operation, the patient being meanwhile placed in an apparatus so arranged that pressure is applied over each side of the ilium and the great trochanters, so as to push the innominate bones inwards. This diminishes the defect in the anterior abdominal wall very greatly; the prolapsed mucous membrane recedes and a deep furrow is left, over which the soft parts can be brought together without great tension.

In about a fortnight's time, the second stage is proceeded with by making an incision at the point of junction of the skin with the mucous membrane all around the defect in the bladder, and dissecting up the

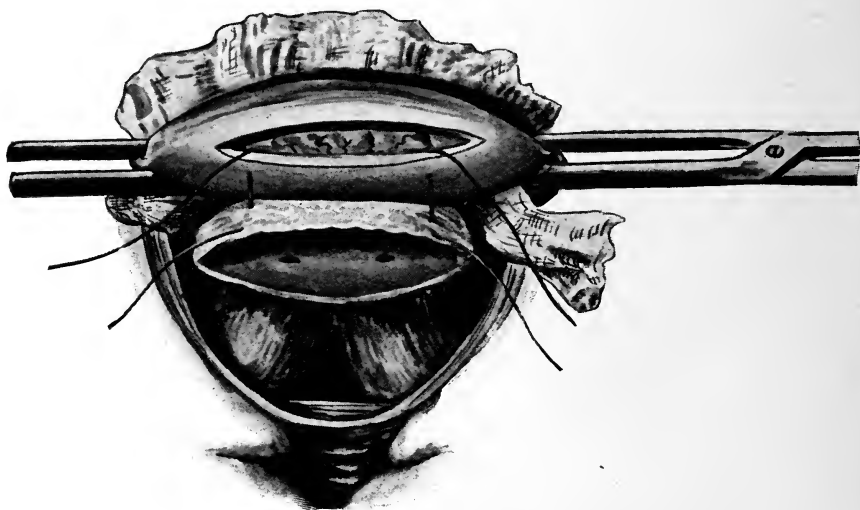


FIG. 117.—PLASTIC OPERATION FOR ECTOPIA VESICÆ. *Third stage.* The bladder is cut away, except that portion immediately around the ureters. These latter are freed for about an inch and a half, a considerable amount of tissue being left around them in order to preserve their vascular supply. A coil of pelvic colon is brought out and clamped. The muscular coat of the bowel is then incised, without dividing the mucous membrane, and sutured to the muscular wall of the bladder. The deeper parts of the wound are carefully packed off. The mucous membrane of the colon is then incised, and the suture completed.

mucous membrane from the peritoneum for a short distance. Care is necessary in doing this, as there is little tissue between the peritoneum and the mucous membrane, and the former may easily be wounded. The edges of the mucous membrane, which should then come together readily, are united by a continuous catgut suture, and it only remains to undermine the skin all round with a few sweeps of the knife and unite the raw edges with silkworm-gut sutures in the middle line. The operation for the cure of the epispadias should be deferred to a later period, and should preferably be that recommended by Thiersch (see p. 333).

Transplantation of the ureters.—The ureters may be transplanted into the vagina, the pelvic colon, or the upper part of the rectum, and the vesical mucous membrane completely removed. It is best to

transplant the ureters into the pelvic colon, as that part of the intestine will hold a considerable quantity of urine, and the patient may go three hours or more before emptying the bowel; when the implantation is made into the vagina there is constant dribbling of urine. The great objection to transplantation into the bowel is the risk of septic infection spreading along the ureter, but experience shows that this is much diminished when the ureteral orifices are transplanted bodily into the bowel; the valvular orifices appear to prevent the passage of infective material upwards.

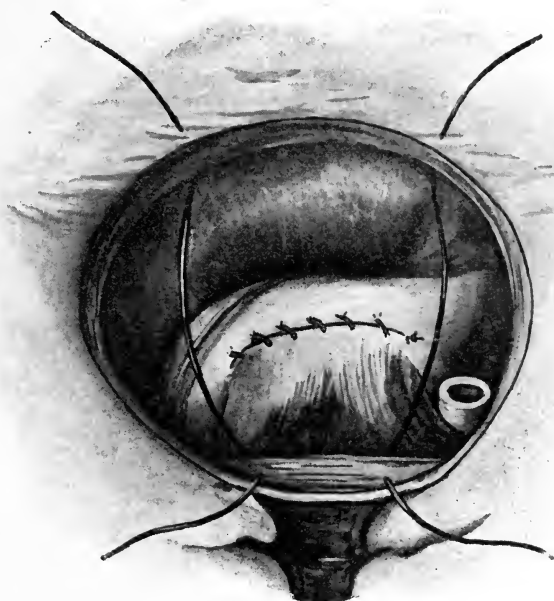


FIG. 118.—PLASTIC OPERATION FOR ECTOPIA VESICÆ. *Fourth stage.* The operation is completed. The peritoneum is pushed back as a flap to shut off the general peritoneal cavity from the region of the anastomosis. A drainage tube is inserted at the side of the anastomosis which goes to the bottom of Douglas' pouch. Two or more sutures are passed, uniting the ligamentous symphysis to the fibrous tissue at the upper margin of the opening. The wound is packed. The sutures are tightened some days later when the wound is granulating.

The wall of the bladder is carefully cleansed and then detached from the peritoneum from above downwards (see Fig. 115). Sometimes there is very little tissue between the two, and care must be taken not to open the peritoneum before the bladder is detached. In other cases there is quite a thick layer of tissue, and the wall of the bladder is dissected up easily. When this detachment has been carried down close to the ureters—which are rendered prominent by inserting bougies into them—the peritoneum is opened, the ureters are traced down to their entrance into the bladder, and the vesical mucous membrane is clipped away entirely, except in the immediate neighbourhood of the ureteral

area (see Fig. 116). In doing this, great care must be taken to avoid injury to the ureters, as these pass much more forward than in the normal individual. They may run along the brim of the true pelvis almost to the attachment of the ligament which represents the symphysis. The ureters should not be cleanly dissected out, but enough tissue should be left to provide for their vascular supply. The sigmoid loop of the pelvic colon is then brought out on to the abdominal wall, the peritoneal cavity packed off, and a clamp applied to the loop of bowel (see Fig. 117). A longitudinal incision is now made into the bowel nearly corresponding in length to the strip of mucous membrane containing the two ureteral orifices, and this strip is implanted into the rectum; a double

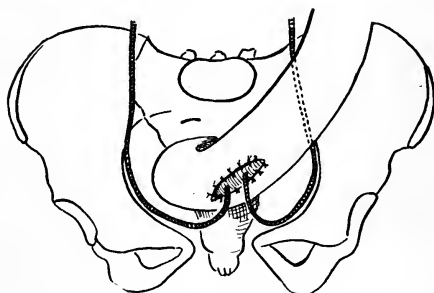


FIG. 119.—ECTOPIA VESICÆ. Diagram to show the relationship of the parts in anastomosis of the ureters to the pelvic colon.

row of sutures is used, the deeper one uniting the mucous membrane of the bladder to that of the intestine, whilst the superficial one brings together the muscular coats of the bowel and the bladder. If possible, the ureters are then embedded in the wall of the bowel by a row of Lembert's sutures, and the peritoneum tucked back behind the colon.

A drainage tube is then passed down to the bottom of the pelvis, and the wound packed with gauze, one or two stitches being passed between the ligamentous symphysis and tied after the gauze is removed (see Fig. 118).

This operation has been done extra-peritoneally by Peters, of Toronto (*British Medical Journal*, June 22, 1901), but we do not think any real advantage is to be gained by it. There is really less risk of serious sepsis when the peritoneal cavity is opened than when the pelvic cellular tissue is widely opened up.

The number and variety of the operations proposed for this condition are in themselves evidence that surgical opinion is very unsettled as to the best method of dealing with these cases. We are inclined to favour the transperitoneal method of transplantation of the ureters rather than a plastic operation, but it must be confessed that the mortality is high.

PATENCY OF THE URACHUS.

This condition is much rarer than that of extroversion, and in it the urine generally escapes through the umbilicus. The rest of the urinary apparatus may be normal. The patient has practically a cutaneous urinary fistula.

TREATMENT.—If a probe shows that the urachus between the fistulous opening and the apex of the bladder is pervious, an attempt may be made to pare the fistulous opening and to bring the edges both of the urachus and the abdominal tissues together so as to give a firm union and close the fistula. Should this fail or should the lower portion of the urachus not be pervious, the fistulous track must be dissected out and the opening into the bladder inverted and closed by Lembert's sutures.

In some cases the bladder is projected up in a cone-shaped manner ; in them excision of the apex of the cone, followed by inversion and suture of the edges, is the proper practice.

CHAPTER XLII.

INJURIES OF THE BLADDER.

OPEN WOUNDS.

OPEN wounds of the bladder, as distinguished from lacerations or ruptures, are most commonly met with in military surgery ; in civil practice they usually follow falls upon some sharp object, such as a spike, which either traverses the abdominal wall or the pelvic outlet. The bladder may be wounded in operations, such as excision of the rectum, hysterectomy, or operations for femoral hernia, or portions of the organ may be removed designedly, as in cases of malignant growth.

In all these cases there is an external wound in the region of the bladder from which urine escapes continuously ; under such circumstances the only alternative diagnosis to wound of the bladder would be wound of the ureter.

TREATMENT.—The treatment of these injuries must be directed firstly to the repair of the damage to the bladder wall, and, secondly, to the provision of drainage so that urine shall not collect in the peritoneal cavity or the pre-vesical cellular tissue.

The first thing to do is to expose the seat of injury thoroughly. When the bladder has been wounded accidentally, or intentionally, during the course of an operation, the seat of the injury will be exposed to view, the edges will be cleanly cut, and the obvious procedure is to suture them at once (see p. 437). In the case of accidental wounds, the procedure will depend on the situation and the nature of the injury, especially on whether the injury affects the extra-peritoneal portion of the bladder or whether it communicates with the peritoneal cavity, and also on whether it is a clean-cut or a contused wound, such as may be caused by a bayonet or a bullet. In any case, the bladder should be exposed from the front, and if a communication with the peritoneal cavity is found, the abdomen should also be opened. When the opening is more or less clean cut—as in punctured wounds—it should

be sewn up with a double row of sutures, if possible. When it is due to a bullet, there will probably be two openings in the bladder, and the edges will be contused; it may therefore be necessary to pare the edges before stitching up the openings, so as to have clean-cut wounds which will unite by first intention.

The next point is to prevent urinary infiltration. When the wound is clean cut and involves a portion of the bladder covered by peritoneum, the urine collects in the peritoneal cavity; after this has been sponged out and the rent in the bladder sutured, there is no need for drainage, and the abdominal wall can be closed in the usual manner. When, however, the wound involves the cellular tissue and a part of the bladder uncovered by peritoneum, it is well to insert large drainage tubes so as to allow the freest possible escape for the discharges. Urine must already have infiltrated the cellular tissue to some extent in these cases; and although the small amount that has entered the tissues will not do any great harm if the urine is aseptic and the wound kept free from further infection, there is nevertheless a risk of serious septic complications; moreover, the wound may not unite satisfactorily and leakage may occur subsequently.

A point in the *after-treatment* which requires consideration is whether or not a catheter should be left in the bladder. The great objection to this procedure is the risk of introducing sepsis, and when the wound is clean cut and the opening in the bladder has been satisfactorily closed, it is best to leave the patient to pass water naturally. On the other hand, when there is an extensive rupture of the bladder—and especially if the wound is contused—it is hardly safe to allow the bladder to become distended, and, besides, every time the patient passes water the stitches are pulled upon and the union may give way. In these cases, therefore, it is well to tie in a catheter for a few days, especially when the wound has involved the portion of the viscus uncovered by peritoneum.

RUPTURE.

The bladder may be ruptured without there being any wound in the skin. This accident is a common complication of fracture of the pelvis, and the bladder may be lacerated by a sharp fragment of the pelvis, or the urethra may be injured and the laceration may extend into the neck of the bladder. In some cases, the wall of the bladder may be ruptured without any perforation from without. This can only occur when the bladder is distended, and usually takes place in elderly subjects with large prostates as a result of a blow upon the anterior surface of the abdomen. It may also occur from violent compression of the abdomen without fracture of the pelvis, and it is said to occur during severe straining in passing water in people who

have atrophied and distended bladders. The rupture may be either extra- or intra-peritoneal, or both, and the gravity of the injury is increased if the urine is septic.

When the rupture of the bladder is only a complication of a severe injury, such as fracture of the pelvis, the *symptoms* will be due partly to the fracture and partly to the injury of the bladder itself; when rupture of the bladder is the only lesion, the symptoms are due to that alone. There is great shock and frequent desire to micturate, little or no water being passed. If the patient can pass water, as may be the case when the rent is small and extra-peritoneal, the urine will be blood-stained; when, however, there is an extensive intra-peritoneal rupture, all the urine will escape through it, and none through the urethra. When the urethra is ruptured and the rent extends into the bladder, the symptoms will be mainly those of ruptured urethra (see Chap. XXXIII.), and the laceration of the bladder may be overlooked; the latter, however, is the most important, as the bladder injury requires immediate treatment. The diagnosis of rupture of the bladder will be confirmed by signs of urinary extravasation into the pre-vesical cellular tissue in cases of extra-peritoneal rupture, or into the peritoneal cavity when the rupture is intra-peritoneal. In extra-peritoneal cases, there will be a tender boggy swelling, dull on percussion, extending up behind the pubes, and accompanied in a short time by all the signs of extravasation of urine (see p. 394). When the rupture is intra-peritoneal, symptoms of serious peritoneal irritation will set in along with the signs of a collection of fluid at the most dependent parts of the peritoneal cavity, followed very quickly by those of peritonitis.

The diagnosis is finally made by examining the interior of the bladder with an instrument. In doing this there is always a risk of introducing septic material, and therefore it should not be undertaken until the surgeon is prepared to proceed to any operative measures that may be necessary if rupture of the bladder is found. It is best to use a sterile metal instrument—preferably, a short-beaked catheter (No. 10 English), and care must be taken to avoid the introduction of septic material (see p. 374). If the rupture of the bladder is associated with laceration of the urethra, the passage of an instrument may be difficult or impossible, and the treatment of the case should then be conducted on lines similar to those for ruptured urethra (see Chap. XXXIII.).

When the catheter has reached the interior of the bladder, the rent may be made out, the point of the catheter passing through it, either into the peritoneal cavity—whence it may draw off blood-stained urine from the recto-vesical pouch—or into the cellular tissue behind the anterior abdominal wall. The freedom with which the point of the instrument can be moved and the distance to which it can be passed will also indicate whether the laceration is extra- or intra-peritoneal. In intra-peritoneal rupture, the point can be made to move

all over the abdominal cavity, and the instrument can be passed right up to its hilt without experiencing any resistance ; it must, however, be borne in mind that it is possible to push the intact bladder before the instrument for a considerable distance, especially in children, in whom a sound can sometimes be passed on until its point is felt close to the umbilicus.

Should there still be any doubt in the surgeon's mind, useful confirmatory evidence can be obtained by injecting fluid into the bladder and seeing how much returns. All the urine in the bladder is first drawn off, and a measured quantity—say, six ounces—of warm boric lotion is rapidly injected and then allowed to return into a measure. If there is a rupture of the bladder, the amount returned will be considerably less than that injected. Such a procedure should not be adopted, however, unless the patient is actually on the operating-table and ready for operation.

TREATMENT.—In all cases, the rent in the bladder must be examined, and the best plan is to expose the anterior wall, as in supra-pubic cystotomy (see p. 474), before opening the peritoneum ; the bladder should not be previously washed out, nor should any attempt be made to dis-tend it. If the rupture is extra-peritoneal, blood and urine will be found in the pre-vesical space, and the further procedures will depend upon the conditions found. Thus, a depressed fragment of bone may require removal, and this may have produced a small rent in the bladder, which can be closed by a few Lembert's sutures, or there may be a ragged opening extending in several directions, and possibly also into the peritoneal cavity. If the opening is very irregular and contused and the urine septic, or if the case is not seen immediately after the accident, it is well not to attempt to suture the bladder, but to drain it above the pubes (see p. 482). Under ordinary circumstances, however, if the patient is seen early, if the urine is aseptic, and if there is only a moderately lacerated wound, there is no objection to sewing up the rent as accurately as possible (see Fig. 120). The most important point is to provide for the free escape of urine and blood from the pre-vesical space, and therefore whatever may be done to the wound in the bladder, great care should always be taken to clean out and drain the pre-vesical area.

If the rent is partly extra- and partly intra-peritoneal, the repair of the intra-peritoneal portion should be undertaken first (see Fig. 121). As soon, therefore, as the clots and extravasated urine have been removed from the pre-vesical space, the peritoneal reflection above the bladder should be opened by a median vertical incision, the blood and urine sponged out of the recto-vesical space, and the intra-peritoneal tear closed in the manner described in the next paragraph. A drainage tube should be inserted, the rest of the peritoneum sewn up, and the extra-peritoneal wound dealt with on the lines just mentioned.

Should the rupture be purely intra-peritoneal, the tissues in front

of the bladder will be normal, and the incision in the abdominal wall should be extended upwards so as to open the peritoneum above the bladder; the posterior surface of the organ can then be inspected. The patient should lie flat upon the operating-table until the abdomen has been opened, the rent found and temporarily covered by a flat sponge or abdominal cloth, and all the urine present in the recto-vesical pouch mopped out. He is then placed in the Trendelenburg position,

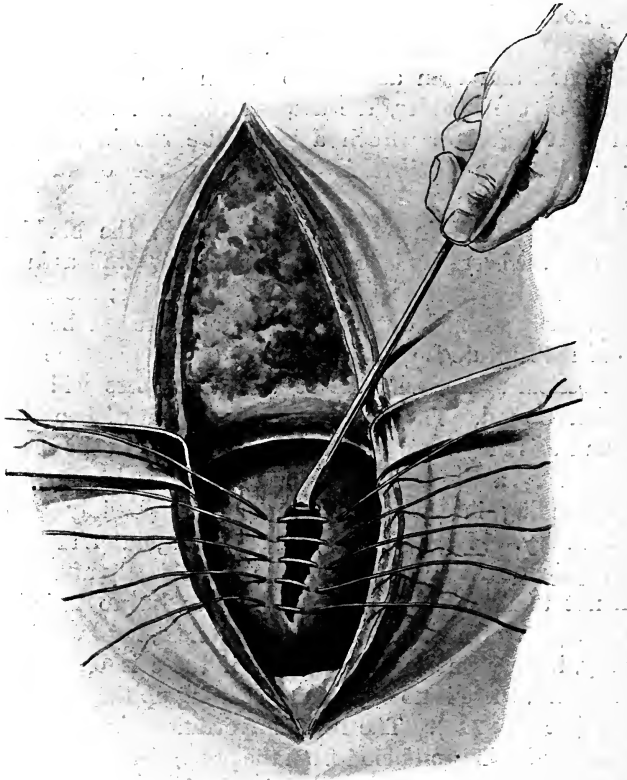


FIG. 120.—REPAIR OF AN EXTRA-PERITONEAL RUPTURE OF THE BLADDER. The wound is rendered accessible by hooking up its upper extremity. The sutures take up only the muscular coat.

the rent in the bladder being kept packed off in order to prevent urine running into the upper part of the abdomen; the intestines are packed off, the bladder is pulled well forwards, and the seat of rupture exposed. This is usually a clean tear, and is readily closed by a double row of Lambert's sutures, the first being interrupted and passing through the serous and the muscular coats, avoiding the mucous membrane, whilst the outer layer is continuous and takes up the serous membrane only. When this has been done, the field of operation is cleansed, the

cloths removed, and the abdominal wound closed, a drainage tube being passed down to the seat of rupture and brought out at the upper part of the abdominal incision.

After-treatment.—The most important question in the after-treatment is whether the patient should be allowed to micturate naturally or whether a catheter should be tied into the bladder. On the one hand, there is apt to be irritation of the bladder and sepsis if a catheter is tied in ;

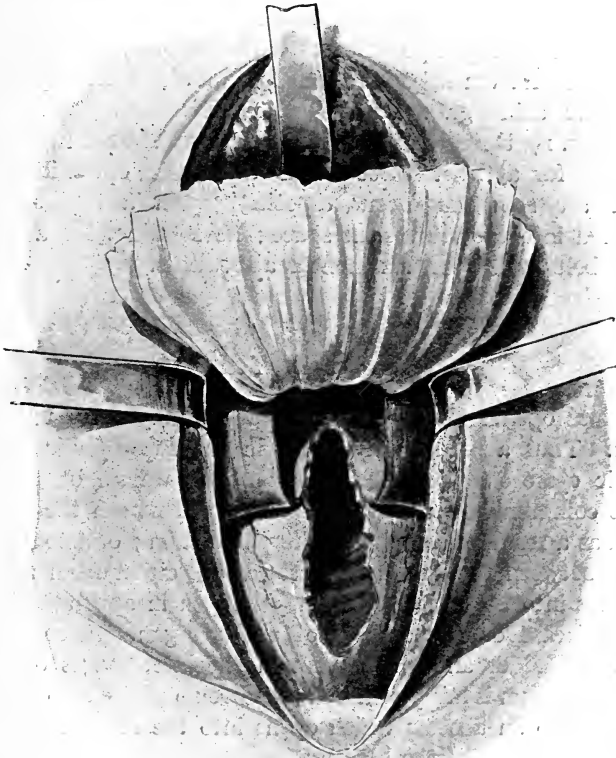


FIG. 121.—REPAIR OF A LACERATION OF THE BLADDER EXTENDING INTO THE PERITONEAL CAVITY. The intestines are packed off and the intra-peritoneal rent is sutured first. Then the rest of the peritoneum is closed and the extra-peritoneal portion of the laceration is sutured.

on the other, there is a possibility of leakage under the strain of passing water if no catheter is employed, and the variations in size of the bladder as it becomes distended and empties itself may cause the stitches to cut through. Instead of tying in a catheter, some surgeons pass one at regular intervals for the first two or three days and draw off the urine. There does not seem to be much to choose between the two methods, and we usually tie in a soft red-rubber catheter for the first three days,

after which the urine is drawn off at intervals whenever the bladder is getting distended. After the first week the patient is allowed to micturate naturally.

In cases of intra-peritoneal rupture, the wound in the bladder generally heals up without trouble, if the patient escapes the first risks of shock and sepsis, and the drainage tube may be left out on the third day. In extra-peritoneal ruptures the treatment must follow the ordinary lines of an open external wound; and if leakage of urine occurs, an Irving's apparatus should be applied and the treatment carried out on lines similar to those for supra-pubic cystotomy (see p. 475).

During the first ten days it is well to administer urinary antiseptics, such as boric acid (gr. x), salol (gr. x), urotropine (gr. xv-xx), or cystopurin (gr. x), thrice daily, and the patient should not be allowed to get about for at least three weeks after the operation, otherwise bulging of the scar may occur, especially when a drainage tube has been inserted into the pre-vesical space; he should wear a well-fitting abdominal belt for at least six months afterwards.

VESICAL FISTULA.

A fistulous opening leading to the bladder may occur under various conditions. Thus a fistula may occur in the supra-pubic region after supra-pubic cystotomy or after a perforating wound of the bladder; a fistulous communication may be established between the bladder and the vagina as a result of sloughing after parturition; or a communication may occur between the bladder and the bowel either from the bursting of an abscess into both viscera, as may happen in appendicitis, or from malignant disease or tuberculosis of either organ. A communication between the bladder and the rectum in the later stages of inoperable cancer of the rectum is fairly common; tuberculous disease of the prostate may give rise to an abscess which opens into the rectum, the prostatic urethra, and the base of the bladder.

When the fistula discharges externally, the diagnosis is readily made by the escape of urine; if the urine comes from the bladder, the flow is continuous, whereas if the opening is in the urethra, the water only escapes during micturition. Recto-vesical or vesico-vaginal fistulae are also easily diagnosed; in both, the orifice of communication can be inspected through a speculum. When, however, the fistula occurs between the bladder and some part of the intestine higher up than the rectum, the diagnosis is not always easy. When there is a communication with the small intestine, gas and faecal material will be found in the bladder in comparatively large quantities. If there is any doubt as to the presence of faecal material, a good test is to administer charcoal by the mouth; its presence will be detected in the urine some hours afterwards. An

examination of the faecal material in the urine may throw some light upon the portion of the bowel involved in the fistula; the contents of the small intestine are fluid, partially digested and contain much bile pigment, while material from the large intestine is fully digested, and the reaction for bile pigment is negative.

TREATMENT.—This will be largely determined by the situation of the fistula and the nature of the affection to which it is due.

Of vesico-intestinal fistula.—The communication between the bowel and the bladder should be cut off if possible, otherwise fatal ascending pyelitis and pyelonephritis are very apt to set in. When the fistula is due to extensive malignant disease, colostomy with complete division of the bowel is indicated, and will relieve the symptoms considerably, although, since the communication is due to growth, a certain amount of septic discharge will still find its way into the bladder.

When the fistula is due to a communication between the appendix or an appendix abscess and the bladder, it will be advisable to open the abdomen, detach and remove the appendix, and then invert and suture the opening into the bladder.

If the fistula is non-malignant in origin, and is situated in the small intestine, the ideal operation is to excise the affected loop of bowel and unite the ends, and then detach the excised portion from the bladder and invert and sew up the opening in that organ.

Of vesico-vaginal fistula.—In these cases the communication may be either low down on the anterior wall of the vagina or high up and almost in the cervical region. The patient should be placed in the knee-elbow position, which allows the anterior vaginal wall to fall down and come readily into view when the posterior wall is pulled well up. A good light and efficient sponging are essential. In the case of a small fistulous opening on the anterior wall, the principle of the operation is to pare the edges of the orifice as for a cleft palate, and then, separating the mucous membrane of the vagina for some little distance all round, close the aperture in the bladder by interrupted catgut sutures which take up the wall of the bladder just external to the mucous membrane; outside this, a second row of silkworm-gut stitches should be inserted, uniting the cut edges of the vaginal mucous membrane. There may be considerable difficulty in the operation owing to the presence of much cicatricial tissue, especially when the fistula has followed sloughing after parturition, and it may be necessary, before undertaking the plastic operation, to dilate the vagina by the introduction of large bougies until the parts are sufficiently stretched to enable the fistula to be got at easily. A point of great importance is to avoid injury to the ureters which may lie close to the field of operation. Their position should therefore be carefully ascertained, and if there is much cicatrization it may be necessary to use a Kelly's tube (see p. 496) or a cystoscope, and introduce a ureteral sound into each ureter in order to render them evident. After the

operation, the vagina is packed with gauze, and a catheter is kept in the bladder for a few days. The gauze plug may be taken out at the end of twenty-four hours, and the vagina frequently irrigated with a 1 in 4000 sublimate solution. The forms of plastic operation which have been devised for this condition are too various to be given here: for these a text book devoted to the special surgery of this region should be consulted.

FOREIGN BODIES IN THE BLADDER.

A great variety of objects—such as lead pencils, hairpins, or portions of a catheter—have been met with in the bladder, and, apart from their size or their liability to penetrate the bladder walls, their mere presence gives rise to irritation, and they soon become encrusted with phosphates and form the nuclei of vesical calculi.

The *symptoms* to which they give rise are mainly those of cystitis (see Chap. XLIII.), and later on of stone (see Chap. XLVI.). The diagnosis is easily made if the true history can be obtained; failing that, inspection by the cystoscope will show the foreign body, and its nature can readily be recognised before it becomes encrusted. Should it have become the nucleus of a stone, its peculiar shape will often lead to a suspicion of its true nature.

TREATMENT.—The foreign body should be removed as soon as possible, and its removal is comparatively easy in the female, in whom it is perhaps more common than in the male, and in whom the urethra may be dilated, and the body removed by suitable forceps; it will hardly ever be large enough to require a cutting operation. In the male, however, the case is different. In certain cases—e.g. when a piece of catheter is in the bladder—a lithotrite may be employed, and it may be necessary to break up the foreign body with it before it can be extracted safely; if the body is quite small it may be washed into the eye of a large evacuating-catheter. If the body is not suitable for this method of treatment it should be removed by supra-pubic cystotomy.

CHAPTER XLIII.

CYSTITIS.

CYSTITIS may be primary in origin or may arise secondarily to inflammatory conditions of other structures in the immediate vicinity of the bladder; it may also be acute or chronic. It is most common in adult and advanced life, and is rare in young subjects, the explanation of this fact being that the various diseases so often complicated by cystitis occur chiefly in adult life.

All forms of cystitis are due to bacterial infection, and in some this is the sole cause, while in others the disease is a complication of other conditions, such as stricture or enlarged prostate. The organisms producing it most frequently enter through the urethra, one of the commonest sources being the passage of instruments. The organisms may also reach the bladder from the urethra in gonorrhœa and in cases of retention with overflow, or they may find their way from the kidney when pyelitis or pyelo-nephritis is present, and possibly also sometimes from the blood, as in typhoid fever.

We may divide cystitis into three large groups:—

1. Those in which some pre-existing condition predisposes the bladder to infection. Here the cystitis is secondary, and its treatment must be considered in connection with that of the primary condition; examples of this are stricture of the urethra, enlargement of the prostate, and vesical calculus.

2. Those in which the bladder affection is part of a microbic disease, such as gonorrhœa or tuberculosis. These are discussed in connection with those diseases.

3. Those in which the cystitis is primary. Here, however, there are generally some previous conditions which favour the development of the organisms, especially such as interfere with the proper evacuation of the bladder or the nutrition of its walls: a typical example is cystitis in connection with paraplegia.

A great variety of organisms are found associated with cystitis, amongst the commonest of which are the bacillus coli and various forms

of cocci which decompose urea and give rise to ammoniacal urine; the ordinary pyogenic organisms may also be present, and specific bacteria, such as the gonococcus or the typhoid bacillus.

ACUTE CYSTITIS.

The inflammation may be superficial and affect the mucous membrane alone, or it may involve the submucous coat. In the acute catarrhal form, the mucous membrane is injected, and there are numerous ecchymosed spots on it. Superficial ulceration may also occur if the disease lasts for any length of time. When the inflammation has extended beyond the mucous membrane, the submucous and muscular coats become thickened and lose their elasticity, and in rare cases abscesses may form and burst into the bladder. In these cases, the bladder shrinks and is no longer easily dilatable, and may even become adherent to other structures. A more severe and less common form is that known as 'membranous' or 'diphtheritic cystitis' in which there is violent inflammation of the bladder wall followed by necrosis of the mucous membrane with extensive membranous deposits on the surface which peel off and are discharged as more or less complete casts of the bladder.

In *acute cystitis* the first *symptoms* are increased frequency and urgency of micturition. The pain is sometimes very great and is most marked at the end of micturition as the bladder contracts to expel the last few drops of urine. There may be much vesical tenesmus, and the patient suffers from a condition closely resembling incontinence. There is generally a sensation of weight in the perineum and tenderness in the hypogastric region. The urine is turbid from the presence of pus and may be ammoniacal; if it is alkaline, the pus becomes thick, ropy, and tenacious. Blood may be present in the urine, but usually in such small quantities as only to be demonstrable by the microscope. There is loss of appetite, sleeplessness, and a moderate degree of fever.

In *sub-acute* cases the symptoms are less marked. The typical forms are those due to gonorrhœa, stone, or stricture of the urethra. Here the frequency of micturition is less, there is pain in the glans penis during and at the end of micturition, some tenderness or uneasiness above the pubes or in the perineum, and pus and much mucus in the urine.

In *membranous or diphtheritic cystitis*, the symptoms may be extremely severe. The pain is generally widespread and radiates into the loins, thighs, and abdomen, whilst the urine contains large quantities of mucus and is strongly ammoniacal and sometimes very foul; in bad cases much blood is present. When gangrene of the bladder wall occurs, the urine is putrid or fæcal in odour, brown in colour, and contains shreds of necrosed mucous membrane. The temperature in these cases may range from 102° to 104° F., and there is anorexia, sleeplessness, and low

muttering delirium, and the case ultimately terminates in suppression of urine, coma, and death.

The *prognosis* depends largely upon the cause. When the disease is secondary to some obstruction to the outflow of urine, it usually subsides readily when the obstruction is removed, provided that the mischief has not lasted long enough to cause serious changes in the kidney. Cystitis occurring in connection with puerperal or typhoid fever is however a very grave disease.

Various *complications* may arise during the progress of the case. Amongst the most common is ulceration of the mucous membrane, which may be due to direct injury to the bladder wall from the use of instruments, but most commonly to sloughing of the mucous membrane from the severity of the inflammation, as in typhoid or puerperal fever. The ulcers rarely go on to actual perforation of the bladder wall, but they may lead to considerable peri-vesical inflammation indicated by pyrexia, often with rigors, and a gradually increasing area of dullness above the pubes in which suppuration ultimately takes place. When gangrene of the mucous membrane occurs, the case generally ends fatally. Another serious complication that is met with more often in the chronic forms of the disease, is ascending pyelonephritis from direct extension of the inflammatory mischief to the ureters and the pelves of the kidneys; when this condition becomes established, the outlook is unfavourable, as it is very rebellious to treatment.

TREATMENT.—When the affection is secondary, the removal of the cause is of the first importance. When, however, there is no definite primary cause the treatment must be directed to the relief of the inflammation itself.

Prophylaxis.—The disease is frequently set up by the introduction of septic material into the bladder through the urethra, and therefore any case requiring instruments, either for examination or treatment, must be handled with great care. These precautions are referred to on p. 374.

When acute cystitis is established.—The objects of the treatment are to give rest to the bladder, to render the urine bland and unirritating, and to make the bladder and its contents as unfavourable a soil for the growth of bacteria as possible. In all except the gravest forms of acute cystitis the treatment is mainly medicinal and general.

In order to give rest to the bladder, the patient should be kept in bed with the pelvis raised and the knees drawn up so as to relax the abdominal muscles and diminish the pressure on the bladder. Raising the pelvis causes the intestines to gravitate upwards, and so further relieves pressure. The bowels must be freely opened so as to diminish congestion, and the patient will experience great relief from hot applications, the best of which are hip-baths, as hot as can be borne, several times a day; immediately after the bath the patient should be put back to bed between

blankets. In the intervals, hot fomentations should be applied above the pubes and to the perineum, and in bad cases the rectum may be frequently irrigated with hot water. The distressing tenesmus is best relieved by opium if the state of the kidneys permits; if the pain is very severe, subcutaneous injections of morphine may be required, but in most cases half-grain morphine suppositories or an enema containing thirty drops of laudanum in two ounces of starch are more valuable. When the tenesmus is excessive, a catheter may be passed into the prostatic urethra, and fifteen drops of a 4 per cent. solution of novocaine introduced.

In order to render the urine unirritating, large quantities of diluent drinks should be given, so as to dilute the urine freely. Infusion of linseed, decoction of triticum repens, barley water or toast and water, may be given. The only food in the early stage should be milk; subsequently, fish, milk puddings, and white meats may be allowed, but spiced dishes and red meat should be avoided. When the urine is strongly acid, as is often the case in the early stages of acute cystitis, alkalies, such as bicarbonate of soda (gr. xx), liquor potassæ (℥ x), or citrate or acetate of potash (gr. xx) may be given frequently. Urinary antiseptics, such as boric acid, salol, cystopurin, or urotropine, in ten-grain doses, are of value when the urine is foul, and particularly when the more acute condition is beginning to pass off. Quinine hydrochloride may be given internally in doses of three grains three times a day.

Irrigation of the bladder is not required or desirable in the ordinary cases of acute cystitis, but it may become necessary when the urine is very foul, and drainage through a catheter tied into the bladder may be called for if the latter is not too sensitive. If irrigation is necessary, the best plan is to employ a double-way catheter, occasionally closing the outflow so that the bladder may be gently distended and the pus dislodged from its folds. Irrigation performed in this manner often arrests the decomposition. The fluid used should be normal saline solution or boric lotion at the body temperature. Strong antiseptics or astringents should be avoided in the acute stages.

When the disease becomes sub-acute and the inflammation has almost subsided, but there is still a considerable amount of mucus in the urine, drugs which exert powerful control over the secretion from the bladder may be employed, such as turpentine (℥x), terebene (℥x), oil of sandal-wood (℥xv), or tincture of cantharides (℥v), and, unless there is distinct alkalinity of the urine, alkalies are generally valuable. Should the inflammation not clear up entirely, some form of intra-vesical medication will be indicated. In the first instance, warm boric lotion may be used, but, as the disease becomes more chronic, it may be replaced by resorcin (5 to 10 per cent. solution) every alternate day. One of the best injections is nitrate of silver ($\frac{1}{2}$ per cent. solution), half

a dram of which may be introduced and left in the bladder. Iodoform and glycerine emulsion (10 per cent.) has also been used.

In cystitis due to lesions of the spinal cord, the affection is rarely acute. Frequent irrigation of the bladder should be employed, and this is done through a catheter possessing a backward flow. The irrigation should be begun directly the tube has been introduced into the external meatus, and the instrument should be passed slowly down into the bladder; boric and various other weak antiseptic lotions may be used twice a day, and the irrigation is best done with a funnel (*vide infra*). After each irrigation, half an ounce of a solution composed of two ounces of glycerine, one ounce of biborate of soda, and two ounces of water, may be injected into and left in the bladder. When there is a large quantity of viscid muco-pus which the bladder cannot expel, the irrigation may be performed with a solution containing a quarter to half a grain of salicylic acid with two or three grains of biborate of soda to the ounce. The administration of urinary antiseptics (see p. 446) by the mouth is of great value.

Should there be retention with overflow, a catheter must be tied in for a few days (see p. 342) so as to provide for continuous drainage, and subsequently a catheter should be passed at intervals of six to eight hours and irrigation employed as above described. Scrupulous care must always be taken with the aseptic management of the case. When there is true incontinence, no catheter is necessary, and the patient need only be provided with a suitable urinal, but the glans penis and the meatus should be frequently washed with 1 in 2000 sublimate solution, and the urinal should be frequently changed and disinfected.

In membranous or gangrenous cystitis, the bladder is practically a foul abscess cavity into which urine flows, and nothing but perfect drainage will give the patient a chance. Catheterisation, or irrigation of the bladder, will not meet the requirements of the case; the bladder must be opened either above the pubes or from the perineum. A median perineal section (see p. 348) is the best method. A large drainage tube is inserted into the bladder and connected with a longer tube by means of a small piece of glass tubing through which the flow of urine can be inspected; the end of the tube is carried into a basin containing 1 in 2000 sublimate solution. Iodoformed gauze is packed around the tube and an antiseptic dressing applied outside. If the patient can bear it, the bladder should be irrigated from time to time by attaching a funnel to the end of the tubing and running warm saline solution or boric lotion in and out of the bladder. It is essential not to introduce air into the bladder, and therefore the tube and funnel should be filled with fluid and clamped before being attached to the glass tube. The funnel is then raised about a foot above the level of the pelvis, and the fluid run in very gradually. If the patient experiences discomfort, or a desire to evacuate the bladder, the funnel should be lowered and the

fluid allowed to escape. As a rule the organ is so sensitive that it will not bear much distension, and only an ounce or two can be run in at a time. Strong antiseptics should be avoided, as proper disinfection by their means is out of the question. The tube may occasionally become blocked with shreds of membrane, which may be pulled out with a pair of forceps. Perineal is better than supra-pubic drainage, partly because the evacuation is more complete, and partly because it avoids the danger of infiltration of the pre-vesical cellular tissue with the putrid urine. The tube and tubing should be changed once or twice daily, and the fresh tubes employed should be boiled before use.

The patient's general condition is so bad that stimulants are required. When the pulse is soft and rapid, and there is great restlessness and muttering delirium, an ounce of brandy or whisky should be given every three or four hours, together with two or three grains of hydrochloride of quinine every three hours, either in milk or in combination with dilute sulphuric acid. Opium must be very cautiously given, and bromide of potassium (gr. xxx), with ten grains of hydrate of chloral, should be employed in preference; if these fail, however, opium must be resorted to. Vaccines are not of much use in these acute cases.

CHRONIC CYSTITIS.

Chronic cystitis is usually due to some local cause, such as a stricture, enlarged prostate, or stone. Occasionally, however, the acute attack may pass into a chronic condition, and alternating attacks of acute and chronic cystitis are not uncommon.

Chronic cystitis is a chronic catarrh of the mucous membrane, which becomes thickened; the sub-mucous cellular tissue may also be affected. Erosion of the surface of the mucous membrane may occur, and there may be hypertrophy of the muscular bundles and the formation of a fasciculated or, later, a sacculated bladder. In some of these cases the bladder becomes enlarged and thinned, while in others its capacity diminishes and its walls are much thickened.

The *symptoms* only differ in degree from those of the acute form. There is frequent painful micturition, with pus and mucus in the urine; the frequency as a rule is only slightly marked at night. The pain rarely amounts to more than a slight scalding on micturition and smarting at the tip of the penis. There may be some tenderness on pressure above the pubes or in the perineum, but as a rule there is merely an uneasy feeling, especially when the bladder becomes slightly distended. The urine contains most pus at the beginning and end of micturition, showing that the affection is chiefly confined to the trigone and neck of the bladder, and this is well seen if the patient is made to pass urine into three glasses; pus will be found in the first and last, but will be almost entirely absent from the intermediate specimen.

The affection has to be distinguished from tuberculosis of the bladder, and from neuralgia of nervous origin, such as occurs in locomotor ataxia, also from suppurative pyelitis and pyelonephritis. In pyelitis, the frequency of micturition is as marked during the night as during the day, and the pus is intimately mixed with the urine. There may be no scalding on micturition, and there is no tenderness on pressure over the neck of the bladder or when the organ becomes distended, whilst there is generally some tenderness or swelling in the region of the affected kidney together with some elevation of temperature, and the cystoscope will usually show pus issuing from the ureter on the affected side. The diagnosis of tuberculosis of the bladder is dealt with in Chap. XLIV. When the case is of nervous origin, the existence of the primary disease will make the diagnosis clear.

TREATMENT.—The important point is the treatment of the primary condition; that of the cystitis itself is essentially local. The *general treatment* for acute cystitis (see p. 445) should be employed, and the administration of drugs acting directly upon the bladder, such as sandal-wood oil, turpentine, or cantharides, is of advantage. If the urine is ammoniacal, urinary antiseptics (see p. 446) are required; if it is alkaline, but not ammoniacal, benzoate of soda is useful.

Local treatment.—When the symptoms are very slight, irrigation of the bladder (see p. 447) with warm boric lotion, night and morning, will usually suffice if the primary trouble has been removed. The urine is first withdrawn, and as much lotion as the bladder will tolerate is injected with a syringe as rapidly as possible in order to distend the vesical mucous membrane. The washing-out should be repeated until the urine becomes quite clear, and it is well to leave about half an ounce of the lotion in the bladder at the end of the sitting. If the case does not yield to irrigation with boric acid, perchloride of mercury may be substituted. When a strong solution is employed, it is well not to leave any behind in the bladder, as it might cause irritation. When the neck of the bladder and the prostatic urethra are the areas most affected, as in gonorrhœal cystitis, the prostatic urethra should be washed out by a catheter with a backward flow, after the irrigation of the bladder has been completed. Among the solutions employed for washing out the bladder may be mentioned permanganate of potash (1 in 5000), perchloride of mercury (1 in 20,000 to 1 in 5000), neutral solution of quinine (gr. ij ad ʒj), protargol ($\frac{1}{4}$ per cent.), and argyrol (5 per cent.).

In rebellious cases, in which the inflammation is mainly confined to the neck of the bladder, a useful plan is to instil five to ten minims of a $\frac{1}{4}$ to 2 per cent. solution of nitrate of silver into the prostatic portion of the urethra by means of a suitable graduated syringe (see Fig. 122), a few minutes before washing out the bladder. Another plan is to wash out the bladder with plain boiled water, then instil

the nitrate of silver solution into the bladder, and syringe a little boiled water through the catheter before withdrawing it, so as to prevent the silver solution coming in contact with the urethral mucous membrane; the solution is left *in situ* for five or ten minutes, and then the bladder is irrigated with boric lotion, and the strong solution washed away. It is well to perform irrigation with the patient in the recumbent position—at any rate, in the early stages. When he becomes accustomed to the operation, it may be done with advantage in the upright position, as the base of the bladder is thus more thoroughly cleansed. If there is much muco-pus, the bladder may be irrigated with a weak solution of nitrate of silver (gr. j ad ℥viij), or one containing salicylic acid and biborate of soda (see p. 447), or the salicylic solution may be used first and the nitrate of silver employed afterwards. The latter is either allowed to escape entirely, or, in the



FIG. 122.—APPARATUS FOR INSTILLATION INTO THE PROSTATIC URETHRA.

more obstinate cases, half a dram may be left behind. The nitrate of silver solution may be gradually increased in strength.

When the scalding and frequency of micturition are excessive, the treatment will closely resemble that for the acute form of the disease (see p. 445), and it may even be necessary to employ continuous drainage. In the rare cases in which these methods fail, or when continuous urethral drainage cannot be borne, it may be necessary to open the bladder; and here it will undoubtedly be better to open the organ above the pubes (see p. 474), as there is not much danger of septic infiltration of the pre-vesical tissues, while at the same time the surgeon has the great advantage that he can inspect the interior of the bladder and may be able to treat some local condition that is keeping up the inflammation; moreover, a perineal opening is apt to increase the sepsis. The bladder is drained until the urine is free from mucus and pus.

In the female, the treatment will be exactly similar to that in the male, except that, when continuous catheterisation fails to effect a cure, the urethra should be over-dilated and temporary incontinence of urine established. Should this not bring about a cure, supra-pubic cystotomy must be performed.

PERI-VESICAL INFLAMMATION.

This may follow extra-peritoneal rupture of the bladder due either to injury or to perforation in connection with grave cystitis. It may

also arise secondarily to inflammation of the seminal vesicles, the ureters, the pelvic bones, or the Fallopian tubes.

The most common seat of peri-vesical inflammation is the space of Retzius, which is bounded in front by the pubes and the anterior layer of the transversalis fascia; behind, by the anterior wall of the bladder with its covering derived from the posterior layer of the transversalis fascia; below, by the capsule of the prostate and the pelvic fascia; and above, by the approximation of the two layers of transversalis fascia. Purulent inflammation in this region may burrow up under the recti or may pass backwards to the rectum or to the iliac fossa on either side, and the prognosis is extremely grave.

The diagnosis is comparatively easy; there are symptoms of inflammation, accompanied by a brawny, painful induration immediately above the pubes, and fluctuation may be detected at some part of the swelling. The treatment should be free incision and drainage; should it be found that rupture or perforation of the bladder has also occurred, suitable treatment must be adopted for that (see p. 437).

BACTERIURIA.

Micro-organisms are frequently found in the urine in cases of general infection, especially typhoid fever. These usually disappear as the patient recovers, although in the case of typhoid fever they may persist for a long time. There are other cases of 'true bacteriuria' in which organisms—the commonest by far being the *bacillus coli communis*—are present in large numbers without any inflammatory reaction in the mucous membrane of the urinary passages, which seems to tolerate the organism much in the same way as the mucous membrane of the alimentary tract does. In addition to the *bacillus coli*, *staphylococcus albus* and various forms of *proteus* may be found. This condition may last for a long time and may lead to a true cystitis. Cases also occur, intermediate between a pure bacteriuria and a cystitis, in which a few pus-cells and a small amount of mucus are present in the urine. It is probable that in most cases the disease is produced by the passage of organisms from the alimentary tract to the bladder *via* the blood-stream. The affection occurs most commonly in men at or past middle age, and is often associated with enlarged prostate.

The most constant *symptom* is frequency of micturition. Symptoms of absorption of bacterial toxins are as a rule absent, and the onset of severe symptoms indicates that cystitis is present. The urine is often slightly turbid, pale, and acid in reaction.

The diagnosis is made on the bacteriological examination, the organisms being in such numbers that they can be detected readily on microscopic examination.

TREATMENT.—This is not particularly satisfactory. If there is any definite lesion of the alimentary tract, such as appendicitis or colitis, it should receive appropriate treatment. Diuretics, such as citrate and carbonate of potash, and urinary antiseptics, such as urotropine or cystopurine, are of some value, although they often fail.

Sometimes good results are obtained by the use of an autogenous vaccine in increasing doses. Locally, daily instillations of antiseptics, *e.g.* 1 to 2 drams of 1 in 5000 perchloride of mercury solution, or a weak solution of nitrate of silver ($\frac{1}{2}$ per cent.) are recommended. If there is any pus in the urine, the case should be treated as one of chronic cystitis.

CHAPTER XLIV.

TUBERCULOSIS OF THE BLADDER.

THE bladder is not infrequently affected with tuberculosis, which is generally secondary to tuberculosis of the kidney, prostate, or testicle, though in rare cases it may be primary. It may occur at any age, but it chiefly attacks young male adults, and any cause of cystitis, especially gonorrhœa, may predispose to it. Its greater frequency in men is probably accounted for by the fact that the male genital organs are more closely associated with the urinary apparatus than are those of the female.

The tubercles are deposited in the superficial layers of the mucous membrane, and ulcers, varying in size from a pin's head to a sixpence or larger, occur early. The disease generally commences in the trigone, especially near the orifice of one or other ureter, and is in any case most advanced there, but there may be numerous tuberculous ulcers scattered over a large extent of the vesical mucous membrane, and the bladder wall then becomes inflamed and thickened, and its capacity much diminished. The ulcers seldom extend deeper than the mucous and sub-mucous tissues; they may spread into the prostatic urethra and thence to the prostate itself.

The first and most important *symptom* is an apparently causeless and painless frequency of micturition. At first the patient empties the bladder every two or three hours, but the intervals gradually become shorter, until in bad cases the patient may be passing water every five or ten minutes, and a kind of false incontinence is established. The frequency is as marked at night as during the day, and the patient gets no rest. Micturition soon becomes painful and is often unbearable; the pain is worst at the commencement and end of the act. Hæmorrhage is a common and early symptom, and generally occurs towards the end of the act of micturition, and is not influenced by rest; occasionally, large quantities of blood are passed, and the bladder may become filled with clots. As a rule the amount of pus is small, and it is mixed with mucus: when a large amount is present it probably comes from the

renal pelvis. Tubercle bacilli may be the only organisms present, but pyogenic or other organisms are generally found also. Should careful microscopical examination after centrifugalisation fail to detect the tubercle bacillus, its presence may be ascertained by cultivation or by injecting the centrifugalised deposit into animals. There is often polyuria, and the urine may be either acid or alkaline. The disease progresses slowly, often with marked exacerbations, but in the end the patient dies from exhaustion owing to want of sleep, hæmorrhage, or hectic fever, from uræmia, or from tuberculosis elsewhere.

The *diagnosis* as a rule is not difficult in advanced cases, and the insidious onset of the disease and the presence of tubercle bacilli are important points. It must be borne in mind that many cases which were formerly diagnosed as early tuberculosis of the bladder are in reality cases of renal tuberculosis, the vesical symptoms being secondary to the disease in the kidney. The truth of this statement is borne out by the fact that in such cases removal of the kidney relieves the symptoms entirely. A cystoscopic examination will usually clear up the diagnosis (see Chap. L.).

TREATMENT.—The treatment may be medical or surgical, and depends greatly on the presence or absence of tubercle elsewhere, especially in the kidneys. Unfortunately, we do not know of any method that will certainly bring about a cure in any case, although much may be done to relieve the patient's distress.

Non-operative treatment.—*General treatment* should be adopted in all cases. Good hygiene, nourishing diet, and a residence in the country or at the seaside are of the first importance, and moderate exercise is also advisable when the symptoms are not acute. The acuter symptoms may be relieved by hot saline baths, stimulating applications to the hypogastrium, and hot rectal enemata. Cod-liver oil should be given in large doses, and arsenic, creosote, or iodoform pills (half to one grain) are sometimes useful. The various urinary antiseptics (see p. 446) should be employed so as to diminish the associated sepsis, and sedative drugs, such as tincture of hyoscyamus and decoction of triticum repens, are also useful; morphine may be required if there is much strangury. Tuberculin (see Vol. I.) should also be employed.

The *local treatment* consists in irrigating the bladder and introducing into it various drugs designed either to relieve the pain or to inhibit the growth of the tubercle bacillus. For the relief of pain, a 2 per cent. solution of novocaine or preparations of opium are employed, but care must be taken in using the latter because the bladder is ulcerated, and absorption readily occurs. On the whole, anodyne applications are better administered in the form of rectal suppositories. Much relief may be obtained by irrigating the bladder with hot solutions of boric acid, permanganate of potash, or weak sublimate (see p. 449); nitrate of silver, which is useful in other forms of cystitis, is almost always harmful in these cases. Iodoform and glycerine emulsion has been

much used, but is disappointing in its results ; if employed it should be diluted three or four times with water before being injected.

Operative treatment.—This may be directed against the primary focus if the tuberculosis of the bladder is secondary, or it may be limited to the bladder when the disease is primary, when the condition of the bladder does not improve after removal of the primary focus, or when the latter cannot be taken away. In the early stage, the tubercles in the bladder may be few in number and limited to the neighbourhood of one ureter, the primary focus being in the corresponding kidney. If that is the case and the disease is limited to one kidney, as it generally is at first, excision of the kidney should be performed. Even in more advanced cases, in which the kidney is much diseased and a large quantity of tuberculous pus is being poured into the bladder, it should be removed, provided the other kidney can do the work. Primary disease in the prostate must also be dealt with (see p. 407).

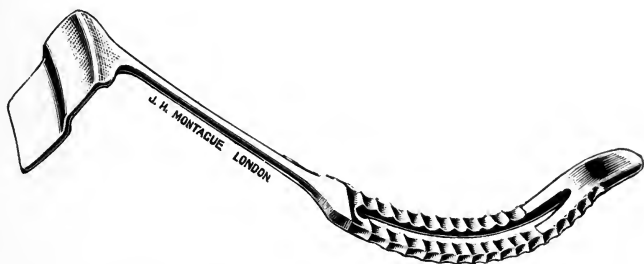


FIG. 123.—THOMSON WALKER'S RETRACTOR FOR SUPRA-PUBIC CYSTOTOMY. The special shape of this retractor ensures wider separation of the bladder walls than of the abdominal wound.

Operative treatment, so far as the bladder itself is concerned, aims at giving it complete rest by opening the organ above the pubes. Even if this fails to cure, it may relieve the patient considerably, as the repeated painful contractions of the bladder soon cease. Perineal drainage is objectionable, because the tube lies in contact with the ulcerated portion of the bladder in a very sensitive area, while it is very difficult to prevent sepsis with an opening in that situation. The supra-pubic operation has the further advantage that the interior of the bladder may be inspected and suitable local treatment applied to the ulcers.

The details of supra-pubic cystotomy are given on p. 474. The bladder is opened, and the edges of the incision through its walls are held well apart by two or three large retractors (see Fig. 123), and the interior of the organ mopped out and examined with the aid of a powerful head-light. Each ulcer should be dealt with in the manner described below, and the mucous membrane must therefore be gone over most thoroughly. The great difficulty in doing this is the constant entrance of urine through the ureters, so that the wound becomes rapidly moist even after the most careful sponging. A very useful aid is the 'caisson' speculum (see Fig. 124), by which areas of the bladder can be isolated, dried, and appropriately

treated. In order to work through this, long-handled forceps, scissors and knives are necessary. Small ulcers may be picked up and snipped out bodily with a portion of the surrounding mucous membrane, any oozing point being stopped by temporary pressure or touched with the electric cautery. Larger ulcers cannot be dealt with in this way; but they may be scraped, or cauterised with an electric cautery or the diathermic electrode. When each ulcer has been treated in turn, powdered iodoform is rubbed in, and, in addition, its surface may be painted over with a saturated ethereal solution of the drug; this should not be used, however, if the ulcerated area is extensive, as sloughing might be caused.

It now only remains to drain the bladder by a large tube projecting into its cavity, but not reaching the trigone, and furnished with lateral

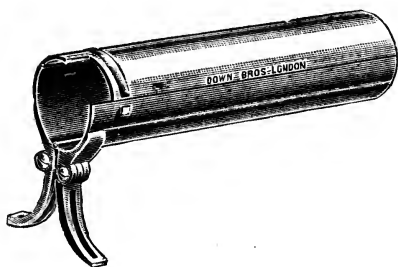


FIG. 124.—'CAISSON' SPECULUM.

holes where it is in the bladder. It should reach down to, but not touch, the internal meatus. The remainder of the incision into the bladder is then stitched up, and it is a good plan to insert one or two sutures between the edges of the portion of the bladder wall through which the tube passes and the abdominal muscles, so as to prevent the two structures being separated. A

second small drainage tube is inserted into the pre-vesical space, and the skin-wound is closed by interrupted silkworm-gut sutures taking up the muscles as well as the skin.

After-treatment.—The foot of the bed is raised so as to take the pressure of the intestines off the bladder, whilst a continuous drainage apparatus (see Fig. 112) is put on over the wound and is left undisturbed for four or five days in order that a definite track may be established around the tube, which is then taken out and a fresh one introduced, and changed daily. The tube draining the pre-vesical space may be left out in three days if no suppuration occurs. The bladder should be washed out twice daily with boric lotion through the supra-pubic tube, and a dram of iodoform and glycerine emulsion (10 per cent.) introduced after the irrigation. Drainage should be kept up until the pus has disappeared and there are no other signs of inflammation; this will take at least six weeks. The greatest care must be observed in the aseptic management of the case, and the skin should be carefully cleansed at each change of dressing. The pubes should be shaved and disinfected from time to time, and the drainage tube boiled each time before it is introduced into the bladder.

This plan of draining the bladder continuously after the local treatment of the ulcers answers fairly well, and is a great improvement upon the method of closing the organ completely.

CHAPTER XLV.

NERVOUS AFFECTIONS OF THE BLADDER.

NOCTURNAL ENURESIS, OR INCONTINENCE OF URINE IN CHILDHOOD.

THIS condition has nothing in common with incontinence of urine met with at other periods of life, and may be divided into several groups:—

(a) **True nocturnal enuresis.**—In these cases there is perfect control over the bladder during the day, while enuresis occurs at night. The condition is probably always nervous in origin, and the act of micturition is purely reflex, being often caused by some psychical phenomenon, such as a dream.

(b) **Nocturnal enuresis with imperfect control during the day.**—Here the patient is obliged to empty the bladder in the daytime immediately the desire is experienced. This condition may be due to several causes, the commonest of which is some peripheral irritation, such as phimosis, congenital narrowing of the urethra, vesical calculus, or worms in the rectum.

(c) **Enuresis both by night and by day.**—The probable cause of this condition is inability of the sphincter vesicæ to resist the passage of urine directly the bladder begins to be distended. In extreme cases, the sphincter is paralysed, and the urine dribbles away as fast as it is secreted, and there is therefore true incontinence; as a result, the bladder becomes permanently contracted and not distensible. This condition is not uncommonly met with as a result of a previous over-distension of the bladder, such as may occur during specific fevers.

Incontinence of urine associated with epileptiform convulsions is one of the most common forms of nocturnal enuresis in the adult male, and Trousseau held that all forms of nocturnal enuresis in adults are due to epilepsy; micturition usually occurs at the end of the fit. Enuresis may, however, occur in the early stage of locomotor ataxia.

The prognosis is very good except in the last form, and a cure is practically certain to result, though the affection may last a long time.

TREATMENT.—(a) **Of true nocturnal enuresis.**—There are three indications for treatment: firstly, to divert the patient's attention from the affection from which he suffers; secondly, to insure light sleep, so that the child may awake immediately the bladder becomes distended; and thirdly, to strengthen the sphincter muscles.

The child should be, consequently, encouraged to think that he will speedily grow out of this repulsive affection, and should not be punished for what is not his fault. He should sleep on a hard mattress, and be lightly covered, and a night-light should burn in the room. He should be taught to lie on one side, and, if there is any difficulty about this, some hard object may be strapped over the spine to prevent his sleeping on the back. Any obstruction to the air-passages—such as adenoids or enlarged tonsils—should be removed, and sources of irritation—such as a long prepuce or worms—should be treated. In all cases the urine should be examined, and any abnormality corrected; if the bacillus coli is present, an autogenous vaccine may be used. The child should be encouraged to drink bland fluids—such as barley water—during the day, so as to dilute the urine and render it less irritating, but nothing should be given to drink after five o'clock in the evening. He should go to bed early, the bladder being emptied the last thing before going to sleep, and he should always be instructed to get up and pass water whenever he wakes. A good plan is to wake young children up three or four hours after they go to bed, in order to establish the habit of passing water. In the case of adults, an alarm clock may be used—set to go off about three or four hours after the patient has retired. If he should find that he wets the bed again in spite of this, the clock should be set again so as to wake him up a second time. In severe cases, benefit is sometimes obtained by counter-irritation to the spine by means of a mustard plaster or a blister.

Amongst the methods of local treatment the galvanic current is useful. The negative pole is placed over the lower part of the spine, whilst the positive is applied to the perineum immediately behind the scrotum. A current of 5 milliampères is applied for about three-quarters of an hour daily. The faradaic current may be alternated with this, one pole being introduced into the rectum whilst the other is applied in turn on the perineum and the supra-pubic region. The child may resent the introduction of the pole into the rectum, in which case the galvanic current alone should be employed.

The diet should be plain; highly nitrogenous food and any article of diet which increases the incontinence should be avoided. The general health should receive attention, and it may be of use to send the child to the country or the seaside for a long holiday. Drugs, such as cod-liver oil or iron, are of value; other drugs supposed to have a specific action are also given, of which those commonly employed are belladonna or atropine: $\frac{1}{120}$ or $\frac{1}{160}$ of a grain of atropine may be given to

children from six to ten years old about tea-time, and repeated at eight o'clock at night. If the pupils become dilated after the first dose, the evening dose should be omitted.

(b) **When there is incontinence both during the day and the night**, any cause of irritation must be removed in the first instance. The further treatment will be very similar to that recommended above, but the bladder must be examined to see whether it has become contracted and if so, the organ should be gradually distended by increasing quantities of warm saline solution. At first a small quantity only can be introduced, but the amount can be gradually increased and, as the bladder becomes dilated, the incontinence will diminish. A good deal of the incontinence during the day is due to excitement, and the child should therefore be guarded against this as much as possible.

(c) **When the incontinence is due to paralysis of the bladder** it is best treated by administering strychnine, or other suitable spinal tonics, combined with the application of electricity locally (*vide supra*).

The following prescription may be used :—

R	Liq. atropinæ sulphatis	.	.	.	.	.	.	℥ ss.
	Liq. strych. hydrochlor.	.	.	.	.	.	.	℥ ij.
	Syrupi	.	.	.	.	.	.	℥ xv.
	Aquam	.	.	.	.	.	.	ad ℥j.

To be given before bed-time, and the dose increased until ℥ij are being taken. *Rhus aromatica* (℥v–xv of the fluid extract) is also useful.

SPASM OF THE BLADDER.

SPASMODIC MICTURITION.

An uncontrollable impulse to pass urine is not uncommon in connection with extreme fright. It may also occur as the result of affections of the prostatic urethra following masturbation or gonorrhoea ; abnormally acid or concentrated urine may also cause it. As a rule, the spasm only occurs during the day, and this is a very characteristic symptom ; the frequency of micturition varies much. If a sound is passed, the prostatic urethra, and sometimes the urethra and the bladder, will be found to be unduly sensitive,

TREATMENT.—Mental excitement must be avoided in cases due to a central origin. In other cases the abandonment of sexual excess, combined with a sea voyage or a long holiday in an interesting locality with plenty of physical exercise, will cause the condition to disappear. The cure may be hastened by the administration of bromide of potassium and, later, of quinine and arsenic. The frequent passage of a sound or the irrigation of the prostatic urethra with hot boric lotion may be useful if the case proves obstinate.

SPASMODIC RETENTION, OR STAMMERING BLADDER.

Here the sphincter vésicæ is at fault rather than the walls of the bladder, and there is difficulty in commencing the act, which may be spasmodically interrupted when once begun; in bad cases there may be retention. The mildest form is the difficulty experienced by many persons in micturating in the presence of others. The condition is usually due to some irritation of the prostatic urethra, and injury and gonorrhœa are the most frequent causes. It may also be met with in connection with constipation and prolapse of the rectum.

TREATMENT.—The best plan is to pass a large well-warmed instrument, and to keep up gentle pressure when the point becomes arrested; this will gradually overcome the spasm, and the instrument will slip into the bladder, and should be left there for five or ten minutes at each sitting. This should be repeated daily so that the sphincter gradually becomes accustomed to relax, and the spasmodic condition passes off. Any existing lesion in the prostatic urethra should receive proper attention (see Chap. XXXVII.).

PARALYSIS OF THE BLADDER.

This may vary much in degree, and may affect either the bladder walls or the sphincter or both. When the sphincter is intact and the bladder only slightly affected, the organ is incompletely emptied, and the urine flows somewhat slowly, and is passed best in the erect position. There is nearly always some residual urine.

Paralysis of the bladder may occur in connection with disease or injury of the brain or spinal cord, with prostatic hypertrophy, after prolonged retention of urine, or in old age. The urine simply trickles out without any force, although the patient may try hard to expel it, and there is a sensation of having imperfectly emptied the organ; micturition is very difficult or even impossible in the recumbent position.

TREATMENT.—In the simpler cases, massage to the supra-pubic region, douches to the perineum, and the use of salt baths are of advantage. The patient should be instructed to empty his bladder as frequently as possible; mild diuretics may be administered, and ergot is a valuable drug. Electricity is often extremely useful; the continuous current is best, but a faradaic current may be employed. One pole is inserted into the rectum or applied over the loin, whilst the other is introduced into the bladder as a specially insulated sound. When the paralysis mainly affects the sphincter, the current should be applied directly to

it by a special sound passed into the prostatic urethra. Great care must be taken in the disinfection of the instruments in these cases, as once a cystitis is set up it is likely to lead to fatal pyelitis or pyelonephritis. The catheter should be passed regularly at least once a day or oftener in bad cases, so as to make sure that there is no accumulation of urine. If the urine becomes foul, the bladder must be washed out two or three times daily, and urinary antiseptics administered (see p. 446).

CHAPTER XLVI.

VESICAL CALCULUS.

THE stones most often met with in the bladder are composed of uric acid or urate of soda ; calculi of phosphate of lime or triple phosphates are probably the next in order of frequency, whilst oxalate of lime stones are less common, and those of cystine and xanthic oxide are quite rare. The calculus may be composed of one of these substances alone, but, except in the case of the two last-named forms, it generally contains more than one. A stone that has remained for some time in a bladder that is inflamed generally becomes coated with a phosphatic deposit ; as the inflammation subsides, fresh deposits of the original substance may occur and this alternation may be frequently repeated.

Vesical calculi may be single or multiple, and vary much in shape ; single stones are usually round or oval, multiple stones are often faceted. Phosphatic stones are usually smooth, whilst an oxalate calculus is so rough that it has received the name of 'mulberry calculus.' Uric acid calculi are brownish-red in colour ; uratic stones are of a duller sandy colour ; phosphatic stones are white ; mulberry calculi are of a dark claret colour.

Vesical calculi may either form *in situ* or, more commonly, they descend from the kidney and increase considerably in size while in the bladder from deposit of fresh salts upon them. Stones which form primarily in the bladder generally occur in connection with some obstruction to the outflow of urine—for example, in enlarged prostate—and there is usually a foreign body, such as blood-clot, a piece of mucus, or a portion of catheter, which acts as a nucleus upon which the salts are deposited.

The affection is more common in men than in women ; in the latter, small stones are much more easily passed and therefore escape notice. The causes are similar to those of renal calculus (see Chap. LV.). A stone in the bladder usually lies well down behind the prostate and near the internal meatus, and alters its position according to the movements of the patient. If the bladder is sacculated, it is not uncommon for the

stone to find its way into one of the sacculi, where it increases in size to such an extent that it cannot escape from it. Occasionally, the stone becomes arrested at the vesical orifice of the ureter on its journey from the kidney, and may lie partly in the bladder and partly in the ureter. In other cases, the calculus may be adherent to the mucous membrane of the bladder, especially when the latter is ulcerated. The surface of an ulcer or growth may also become encrusted with phosphates, and all the symptoms of stone may be produced.

In the early stages, the bladder may be normal, but cystitis supervenes after a time, especially if instruments have been passed. Cystitis increases the sufferings of the patient very much, and phosphates become deposited in large quantities on the stone.

The classical *symptoms* of stone in the bladder are pain, frequency of micturition, and hæmaturia. The *pain* occurs towards the end of the act of micturition as the bladder contracts upon the calculus; it is usually referred to the glans penis, and may persist until sufficient urine has been secreted to separate the bladder wall from the stone. Exercise also brings on attacks of pain owing to the movement of the stone, and it is characteristic that the pain entirely disappears in certain positions and is generally absent at night.

Hæmaturia is an important symptom, and may occur quite early in the case; it is increased by movement. As a rule, a few drops of blood are expelled towards the end of the act of micturition; the bleeding is due to injury of the bladder wall from contact with the stone. The amount of bleeding is slight as compared with that which occurs in connection with vesical tumours.

Frequency of micturition varies very much; it depends largely on movement and on the presence of cystitis. Sudden interruption of the flow of urine, accompanied by sharp pain in the glans penis, often occurs, and this is very characteristic of a small stone falling over the orifice of the urethra.

A valuable point is a *history of previous renal colic*, and this should always be carefully inquired for. When the stone has formed primarily in the bladder there may be a history of previous disease of the bladder, such as cystitis.

In the *diagnosis* of stone, palpation, sounding, cystoscopy, and radiography may be employed. A large stone may be detected by bi-manual rectal or vaginal palpation, but this method is not of much value except in spare subjects and in young children and in females. It usually requires general anæsthesia, but when full relaxation has been obtained, the stone, if large, may be felt between the two hands.

X-rays are of the greatest value in these cases, inasmuch as the size, shape, number, and density of the stone can be estimated. In children, moreover, it is not always easy to sound the bladder without producing a good deal of irritation, and an accurate diagnosis may be made on a

radiogram. This method of examination may, however, fail, because a stone composed of pure uric acid is so transparent to the rays that it does not cast any shadow at all.

Cystoscopic examination of the bladder is the most useful method, and will reveal the presence of a calculus and its relation to the bladder wall (see Chap. L.). Its employment will do away with the necessity for several of the older methods of examination.

The bladder-sound (see Fig. 125) is useful for those who are not expert cystoscopists, for by it the size, consistence, and number of the stones present may be approximately ascertained. It is advisable that the bladder should contain at least two or three ounces of fluid when the sound is used, as in a collapsed bladder a small stone may easily become covered by the folds of mucous membrane and escape notice. Moreover, if cystitis is present, the examination is very painful if the bladder is empty. It is, however, advisable not to have more than five ounces of water in the bladder, because if the bladder is too distended, the beak of the sound may not reach the bladder wall in the post-prostatic region, and a small stone in that situation may escape detection.

The urine should be examined before it is decided to sound the patient, and if it is fœtid or ammoniacal, suitable treatment should be adopted to render it more healthy before the examination is made. It is usually unwise to sound the patient in the surgeon's consulting-room; and especially if he is elderly, it is well to keep him in bed for a few hours before and after it is done. During sounding, the patient lies flat upon his back and the pelvis is raised, so that the stone may fall upwards and away from the post-prostatic pouch. The greatest care must be taken with regard to the disinfection of the sound, the orifice of the urethra, and the hands (see p. 374). It may be well to employ a general anæsthetic if the bladder is very sensitive, but this is not necessary in most cases. A soft rubber catheter is passed, the urine is withdrawn, and three ounces of warm boric lotion are injected. If there is much irritability of the bladder, a small quantity of a 2 per cent. solution of novocaine may be added to this. The sound is then passed, and may strike the stone immediately it reaches the bladder. Should it not do so, a systematic

FIG. 125.—
BLADDER SOUND.



exploration of the interior of the organ should be undertaken. The instrument is inserted as far as possible, and the beak turned to one side; it is then gradually withdrawn until the internal orifice of the urethra

is reached, the tip of the sound being constantly rotated towards the same side. The sound is then passed again to the apex of the bladder, the beak turned to the opposite side, and a similar procedure gone through. The whole of the base of the bladder is thus explored, and the anterior surface may also be examined by depressing the handle and sweeping the beak first over one half of that portion and then over the other. Finally, the beak is directed downwards, and the handle is well raised so as to explore the post-prostatic region. The position of the point of the instrument is known by the mark affixed to the handle. Should the prostate be enlarged, a sound with a much bolder curve should be employed for the examination of the post-prostatic pouch, and that part of the bladder may be rendered more accessible by the introduction of a finger into the rectum.

When the sound strikes the stone, there is a characteristic sharp metallic ring, whilst a foreign body or a new growth gives rise to the sensation of a soft obstacle.

A fairly accurate estimate of the size of the stone may be gained by passing the beak of the instrument over it from end to end, and then from side to side. Its consistence and structure can often be told by the characteristic sound on striking it, the sharp ring of the oxalate calculus differing from the dull sound given by the uratic stone, and both of these being quite unlike the soft grating of phosphatic concretions. When a stone has been found and its size estimated, no further examination is necessary before proceeding to remove it.

Many difficulties are met with in sounding. Thus a stricture of the urethra may grip the shaft of the sound and prevent its proper manipulation, or the stone may be so small as to escape detection among the folds of the bladder. A simple way of overcoming this difficulty is to introduce a Bigelow's evacuating-tube and to connect it with the ordinary lithotripsy evacuating-bottle (see p. 470); this will draw small stones either actually into the evacuator, or, if they are too large, they will strike the eye of the catheter with a characteristic metallic ring.

The greatest difficulty is met with when the stone is encysted, as only a small surface may be uncovered and, even if the sound should strike it once, it may not do so again. An encysted stone may always be suspected if the sound can only be made to strike it in one definite position, and when its beak cannot be made to pass around it. Another difficulty is the presence of phosphatic deposit in the bladder, and this has led more than once to an abortive operation for stone; the indefiniteness and immobility of the phosphatic mass should prevent a mistake of this kind, but in both these instances cystoscopy should be resorted to before operation is decided upon.

Amongst the most important *complications* of stone in the bladder are cystitis with its sequelæ, ascending pyelitis, and pyelonephritis. A stone seldom remains long in the bladder without setting up cystitis,

and this may be of a severe septic character and may exhaust the patient and eventually cause death from 'surgical kidney.' The straining in passing water due to stone in the bladder is a common cause of prolapse of the rectum or hæmorrhoids.

TREATMENT.—As the calculus is a foreign body, the only possible treatment is to remove it by surgical means. In former times, attempts have been, and even now still are, made to dissolve the stone either by drugs administered internally or by injections into the bladder. These attempts are quite futile. There is no doubt that a patient is often relieved by a course of treatment at mineral springs, such as those of Vichy, Carlsbad, or Contrexéville, but this is not due to the waters exerting any solvent action upon a stone which is already present. Symptoms similar to those of stone are frequently due to the passage of highly concentrated urine or small crystals, and this condition may be improved by drugs or by a cure at one of the foregoing health resorts. Even when a stone is present, a certain amount of relief is obtained—probably by the beneficial effect of the waters upon the cystitis present. Some authorities recommend the injection of solvents into the bladder in these cases, but the only condition in which this method might be at all useful would be when there is a large phosphatic incrustation which cannot otherwise be detached; the frequently repeated injection of a weak solution of hydrochloric acid into the bladder may end by loosening the phosphatic deposits, which may afterwards be washed out with an evacuator.

Prophylactic treatment.—This is identical with that of renal calculus (see Chap. LV.), as the stone is generally renal in origin. In order to prevent the formation of phosphatic concretions, when there is cystitis with the presence of mucus, the bladder should be washed out daily with warm saline solution or boric lotion; this is especially advisable in cases of enlarged prostate.

Operative treatment.—At the present day, the surgeon has the choice between removing the stone by lithotomy or litholopaxy.

Choice of method.—It may be said generally that *litholopaxy* is the operation of choice in all cases, whether in an adult or a child, in which the urinary organs are healthy and the stone is not too large. It removes the stone satisfactorily and the patient's convalescence is rapid.

Lithotomy, however, is advisable—

1. When the stone is large; the exact dimensions varying in the practice of individual surgeons.

2. The composition of the stone is also of importance, for a large uric acid stone is easier to crush than a smaller oxalate one, and when there are two or three oxalate calculi it is better to substitute suprapubic lithotomy for litholopaxy.

3. Another condition demanding lithotomy is an insufficiently dilatable bladder, such as occurs in connection with a calculus that has been

present for a long time in a bladder that is the seat of advanced cystitis ; here the bladder walls are thickened and the organ will barely hold more than the stone itself and cannot be dilated sufficiently to allow the lithotrite to be properly manipulated.

4. In stone complicating an enlarged prostate a supra-pubic lithotomy is the more suitable operation as, although the stone may be successfully removed by litholopaxy, the enlarged prostate keeps up a chronic cystitis, and fresh calculi are formed soon after the patient has passed out of the surgeon's hands. By supra-pubic lithotomy, however, not only may the stone be removed but the enlargement of the prostate may also be treated (see Chap. XXXIX.) and the patient cured. Even should prostatectomy not be deemed advisable, the bladder may be satisfactorily drained and the cystitis kept under, and the deposition of fresh stones prevented. The use of a lithotrite in these cases might lead to serious septic troubles.

5. In advanced renal disease, supra-pubic lithotomy is preferable to litholopaxy as the free drainage afforded by the former improves the chance of recovery. At the same time, if the stone is small and the operation likely to be a short one, renal disease does not necessarily contra-indicate litholopaxy as long as the urine is not septic.

6. Stricture of the urethra may necessitate lithotomy in preference to litholopaxy under certain circumstances. A slight stricture may be dilated sufficiently to allow of the introduction of a full-sized lithotrite, and therefore need not influence the question. For dense and narrow strictures, however, a perineal lithotomy is probably the best procedure, the simplest plan being to divide the stricture by a Syme's external urethrotomy (see p. 384), and then to prolong the incision up into the bladder as a median lithotomy. The objection to supra-pubic lithotomy in these cases is the difficulty that may arise in the healing of the supra-pubic wound ; if supra-pubic lithotomy is performed, urethrotomy will be necessary in addition in order to remove the obstruction to the outflow of urine. Therefore, if the stone is small enough for extraction by a median lithotomy there will be no necessity for doing a supra-pubic operation.

7. In stone in the female, the procedure adopted will depend upon the size of the calculus. When this is quite small, the urethra may be dilated and the stone removed through it ; for larger stones, the lithotrite is very suitable, while for very large ones a cutting operation may be demanded, and a supra-pubic lithotomy is better than any form of vesico-vaginal section, which might lead to a fistula subsequently.

8. Litholopaxy is an operation requiring considerable dexterity and constant practice. In districts in which stone is a rare disease and the surgeon is therefore only rarely called upon to treat it he will probably be wiser to perform lithotomy.

Litholopaxy.—Before the operation, preliminary treatment is necessary

for a few days. The patient should be kept in bed, and any cystitis present should receive treatment (see p. 445) ; although the cystitis may not be cured, it may be much improved. Just before the operation, the perineum and pubes, and especially the glans and the meatus, should be disinfected ; the instruments and the operator's hands should also be carefully disinfected. One great danger of litholopaxy is the introduction of septic material into the bladder, and every precaution must therefore be taken, notwithstanding the fact that there is to be no cutting operation. The patient, who should have had the bowels thoroughly cleared out overnight, is placed upon the table with the pelvis raised upon a suitable sand-bag, and the legs encased in long warm stockings and hanging over the end of the table ; the external genitals should be surrounded with aseptic towels. An excellent plan is to cut a small hole in the centre of a sterilised towel and bring the penis out through this ; there is then less likelihood of the towel becoming displaced during the manipulations. The muscular relaxation must be thorough, at any rate in the early stages, and for this reason spinal anæsthesia is valuable in these cases. The urine is first drawn off, and the bladder washed out with warm boric lotion until the fluid returns perfectly clear, and then six ounces of the lotion are injected and left in the bladder. The urethra should next be dilated with Lister's bougies (see p. 372) up to a No. 16 or 18 English in order to facilitate the passage of the lithotrite, and the external meatus must be incised downwards, if necessary, so as to allow the lithotrite to pass easily. The object of this preliminary dilatation is to avoid the risk of damage to the urethra in the neighbourhood of the triangular ligament, especially when the evacuating catheters are introduced.

The beak of the lithotrite (which is generally No. 16 to 18 English size) is now lubricated and introduced into the urethra, the shaft of the instrument being held almost horizontal and parallel to Poupart's ligament, and the penis is drawn up over it until the beak has reached the bulbous portion and cannot be pushed farther down. The shaft of the instrument is now gradually rotated into the middle line, keeping the shaft horizontal and the urethra fully on the stretch, and when it reaches this position the handle is gently raised, so that the instrument becomes vertical and slides on into the bladder by its own weight. No force whatever should be used ; any difficulty will generally be due to the beak not having been pushed far enough down into the bulb. As soon as the point passes the triangular ligament there is no further difficulty, and, as it enters the bladder, the instrument suddenly slides in easily and can be rotated freely.

The stone is now felt for at the base of the bladder with the jaws of the instrument closed. The movements of the lithotrite must be extremely gentle so as not to displace the stone, and the beak should not be allowed to jar against the sensitive vesical neck. When the stone

is felt, the instrument is passed on until its beak touches the upper surface of the stone, and then the lithotrite is held firmly in the left hand and rotated with the right, so that the beak is turned away from the stone when the jaws are separated, the amount of separation of the blades necessary for grasping the stone being known by the previously ascertained measurements of the calculus. The instrument is then rotated back again so that the open jaws lie over and grasp the stone. The stone now lies in the jaws of the instrument which look directly down on to the base of the bladder. The lithotrite is then rotated through 180° , so that the beak looks upwards. If the stone has been carefully seized, there will be no resistance in doing this, whereas, if a fold of mucous membrane has been caught between the jaws and the stone, the latter will not move and must be released and caught again. The greatest gentleness must be used in practising this manœuvre in order to avoid damaging the mucous membrane; moderate distension of the bladder obliterates the folds of mucous membrane and minimises the risk of this.

The jaws of the lithotrite are now pressed firmly on the stone and locked, and the surgeon commences to crush the stone by a series of quarter-turns of the handle until it is felt to give way. In very hard stones this may require great force, and there may come a time when the operator feels that if more force is used the lithotrite may give way before the stone. Under these circumstances it is well to screw down the instrument as firmly as possible, and then to wait for a minute or two without attempting to increase the pressure, as it is found that the stone will sometimes fracture spontaneously under a steady strain. As the stone cracks, some fragments fall away from the jaws of the instrument, and the remainder are crushed into small pieces. The fragments fall into the base of the bladder, and in that direction they are felt for by the closed instrument, and the larger portions picked up in the manner described above.

The whole operation must be done methodically, and each fragment must be located separately and grasped with the lithotrite. By proceeding in this manner, the stone will be reduced to fragments small enough to pass through the evacuating catheter. Just before removing the lithotrite, it is well to rotate the instrument so that the beak looks up into the cavity of the bladder, and then to separate the blades for half an inch or so, and, raising the handle of the instrument, to press the convexity of the jaws well into the base of the bladder; this may cause a number of small fragments to fall into the jaws of the instrument, and they can be crushed up still farther.

Evacuation should be practised as soon as a considerable proportion of the stone has been reduced to fragments. It is useless to attempt to crush up a large stone into minute fragments before evacuating any portion of it, as the débris gets in the way of the jaws of the instrument

and interferes with the manipulations. The largest-sized Bigelow's evacuating-tube that the urethra will admit is passed and attached to the evacuating-bottle (see Fig. 126), which has been previously filled with warm saline solution, care being taken to see that the whole apparatus is full of fluid and contains no air. The tap is turned on, and a stream of lotion is forced into the bladder by gently squeezing the india-rubber ball; this stirs up the *débris*, which, on relaxation of the pressure, is

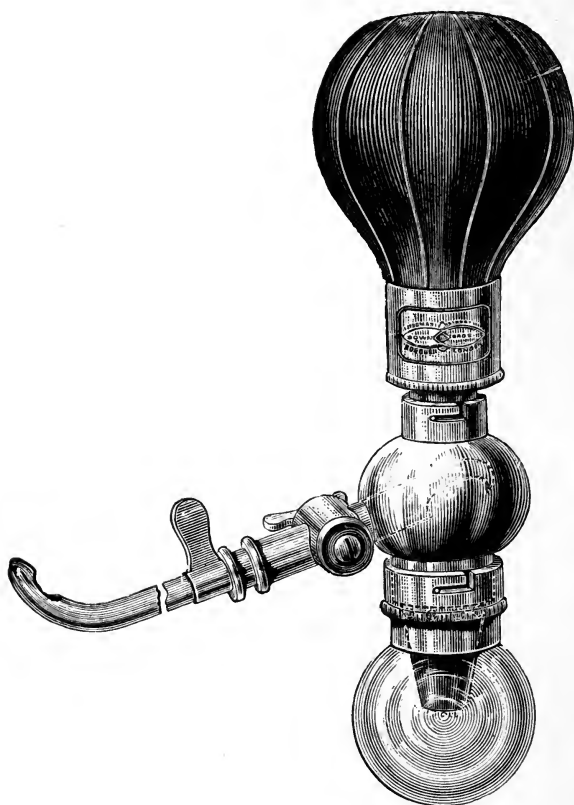


FIG. 126.—EVACUATING BOTTLE FOR LITHOLOPAXY.

sucked back into the evacuator and remains there. This performance is repeated again and again until nothing more comes out. During the evacuation, the eye of the catheter should be turned in several directions so as to make sure that the whole area of the base of the bladder is searched by the stream of fluid. When the surgeon is satisfied that all the fragments have been removed, the evacuating catheter is withdrawn.

A small stone may be completely broken up and evacuated after one crushing, but in most cases it will be found that, after a certain amount of *débris* has passed into the evacuator, fragments of stone can be heard

and felt striking the end of the evacuator, which are too large to pass through it. If this is the case, the evacuator is withdrawn, the lithotrite reintroduced, and the whole procedure gone through again. If there is any difficulty in withdrawing the evacuator, this may be caused by a fragment becoming impacted in the eye of the instrument, and the obstruction must be removed by passing down the stylet before a further attempt is made to withdraw the tube. It is well to empty the bladder before withdrawing the evacuator, and to fill it up again with fresh lotion should a second crushing be necessary. Some surgeons employ on the second occasion a lithotrite with little or no fenestration of the female blade, so as to make sure of crushing the fragments to powder, but the disadvantage of this is that fragments of stone may stick between the blades and prevent their proper closure, in which case it may not be possible to withdraw the instrument.

Before concluding the operation, the surgeon should introduce a sound, and search carefully in all directions for any fragment of stone that may have been overlooked, as the recurrence of stone after litholopaxy is often due to a fragment being left behind. The length of time that the operation occupies varies according to the size of the stone and the skill of the surgeon. Removal of all the fragments at one sitting, and the carrying out of the necessary manipulations so delicately that the bladder wall is not injured, are the secrets of successful litholopaxy, and the surgeon should never be tempted to make only a cursory examination of the bladder for fragments of stone by a desire to finish the operation quickly.

After-treatment.—Any shock is met by the application of heat and the administration of stimulants. It may be necessary to draw off the urine for the first few days; frequently, however, the patient micturates comfortably from the first. Irrigation is not necessary unless the urine has been foul before the operation; irrigation twice daily with a few ounces of warm boric lotion will then suffice. The diet should be light, with plenty of diluent drinks; urinary antiseptics (see p. 446) should be administered internally. Most adults are convalescent at the end of a week, whilst children may be up two or three days after the operation.

Complications occurring during litholopaxy.—*Accidents to the lithotrite.*—There is no operation in which the surgeon is so entirely dependent upon his instrument-maker. Unless the lithotrite be of the finest make, it is liable to fracture or bend under the strain put upon it, and either of these accidents is most serious. Fracture of the blade of the instrument has occurred more than once. Should it happen, a suprapubic cystotomy will be necessary for the removal of the fragments of the lithotrite and the stone.

A far more serious accident is bending of the jaws of a badly tempered lithotrite; this renders it impossible to approximate the blades, so

that a full-sized instrument cannot be withdrawn from the bladder. In such cases, the only procedure is to perform supra-pubic cystotomy and file off the male blade in the bladder. This accident is more likely to occur in children with large stones, as, owing to the size of the urethra, a small lithotrite must be used. It is an argument against lithotripsy in children when the stone is large.

The commonest accident to the lithotrite, however, is clogging of the jaws with débris, and the fenestrated female blade (see Fig. 127) has been adopted to avoid this. If the male blade becomes clogged, and it is difficult to screw the instrument home, the best plan is to release the button and convert the instrument into a sliding one, and then to drive the male down into the female blade sharply and repeatedly. Under no circumstances should an attempt be made to withdraw the instrument until the blades are completely closed. It is better to perform supra-

pubic cystotomy at once than to try to drag out an imperfectly closed lithotrite through the urethra.

Irritability of the bladder.—In some patients, the bladder is constantly contracting, even under deep anæsthesia, and this may not only lead to

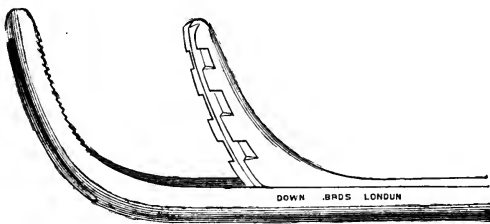


FIG. 127.—THE BEAK OF A LITHOTRITE WITH FENESTRATED JAWS.

ejection of the lotion and so to hampering of the working of the instrument, but fragments of stone may become impacted in the urethra and serious trouble may arise. The anæsthesia must therefore be carefully deepened, and in these cases it is advisable to administer scopolamine and morphine prior to the operation, or to employ spinal anæsthesia.

Hæmorrhage.—In a carefully performed operation, no bleeding of any moment should occur. Severe hæmorrhage is chiefly met with in cases of enlarged prostate or when there is a hard oxalate stone in a contracted and inflamed bladder, and the sharp-pointed fragments injure the mucous membrane. These cases are better treated by supra-pubic cystotomy. Hæmorrhage due to damage of the bladder wall by the lithotrite, or to laceration of the urethra in dilating it or in introducing large instruments, should never occur.

Lithotomy.—There are three forms of lithotomy: namely—supra-pubic, and median and lateral perineal lithotomy. Of these, the perineal operations—which were at one time universally used—have now fallen almost entirely into disuse, owing chiefly to the greater safety of the supra-pubic operation. The following points in favour of this operation may be mentioned:—

1. The supra-pubic operation is the ideal method for large hard stones that a lithotrite cannot crush, and also for multiple calculi. The incision into the bladder can be made of any shape or size that is desired, and the stone can be extracted without bruising the vesical walls, whereas attempts to draw a large or rough stone through an inadequate incision by the perineal route, lead to severe and serious sepsis. Further, supra-pubic cystotomy is valuable for multiple calculi, because the interior of the bladder is open to inspection and a calculus cannot possibly be overlooked.

2. When there is enlargement of the prostate, the supra-pubic operation is valuable because it enables the stone to be removed without damage to the gland. Moreover, operative procedures for the enlargement of the prostate may be carried out at the same time (see Chap. XXXIX.) without increasing the severity of the latter operation.

3. The supra-pubic method is essential for an encysted stone ; by no other means can the aperture of communication between the cyst and the rest of the bladder be properly seen, or suitable measures taken for removal of the stone.

4. When there is advanced renal disease, or cystitis with foul urine, the supra-pubic operation is most valuable because there is no risk of septic absorption from injury to the prostatic plexus, whilst at the same time free drainage is provided.

5. In children with stones too large for lithotripsy the supra-pubic operation should be done, although some surgeons still prefer lateral lithotomy. With the former operation there is no danger of making too large an incision into the neck of the bladder and causing permanent incontinence of urine ; the bladder is largely an abdominal organ in children, and is therefore even more easily exposed than in the adult.

6. In women, the supra-pubic operation is best, if a cutting operation is desirable, as not only can the interior of the bladder be thoroughly inspected, but there is no risk of a subsequent vesico-vaginal fistula.

Supra-pubic lithotomy.—The pubes is shaved and disinfected in the usual manner, and the patient lies upon his back with the pelvis well raised, so that he is almost in the Trendelenburg position. This is useful, as the intestines gravitate towards the diaphragm, and the peritoneal pouch is carried as much as possible out of harm's way.

In order to expose the organ with the least damage to other structures, it is always well to render it as prominent as possible, and we are accustomed to do this by distending it with as much warm boric lotion as it will conveniently hold. The bladder is first washed out thoroughly (see p. 446), and the patient should be fully under the anæsthetic. The amount employed for distending the bladder will vary ; a healthy organ will easily hold from eight to ten ounces, but a contracted one holds much less, and the distension should not be pushed beyond the point at which the bladder commences to make expulsive efforts. The catheter

is now withdrawn, and the urethra is occluded either by tying an india-rubber band around it or by an assistant's fingers. When the bladder is not very distensible, it is well to introduce a bulbous-ended metal sound into the bladder ; by depressing the handle, its point can be made to project beneath the abdominal wall just above the pubes, and the bladder wall can thus be easily defined during the operation.

A vertical incision, $2\frac{1}{2}$ inches long, is now made from the centre of the symphysis pubis upwards. If this is strictly in the middle line it opens up the interval between the pyramidales muscles, and the loose pre-vesical cellular tissue is seen. The abdominal muscles are retracted, and inspection of the pre-vesical tissues will show the line of the peritoneal reflection. The pre-vesical fat is then torn through just above the symphysis and pushed up into the upper angle of the wound, carrying with it the reflection of the peritoneum. Special care should be taken not to open up the pre-vesical cellular tissue behind the symphysis, as this will leave a ragged cavity in which dangerous cellulitis may occur.

The bladder wall is now exposed, and is recognised by its muscular coat and by the presence of large veins in it. A third retractor is used to hold up the fat and the peritoneum, and a couple of sharp hooks or, preferably, two stout silk threads are made to penetrate the whole thickness of the vesical wall, one on each side of the proposed line of incision. The advantage of the silk threads over the hooks is that in the later stages of the operation they are useful in pulling up and steadying the edges of the incision when it is desired to suture the bladder, and are not so likely to tear through as the hooks are. The bladder is then incised vertically in the middle line between the two guides, the knife being inserted at the proposed lower limit of the incision and cutting upwards. When the stone is large and a good deal of space is required, a transverse incision in the bladder wall will give more room than a longitudinal one and the attachment of the recti to the pubic bones may be divided. Directly the bladder is opened, the wound becomes flooded with fluid and the bladder tends to collapse, but its retraction is prevented by the guiding-stitches or hooks already inserted. The incision should be large enough to admit two fingers in the first instance, and may be increased later on if necessary.

As soon as the incision has been made into the bladder wall, a finger is introduced, and the stone felt for and extracted with suitable lithotomy forceps which are slipped in alongside the finger. When the stones have been removed, the edges of the opening into the bladder should be held well up by an assistant, any blood and clots flushed out with warm boric lotion, and its interior examined by the finger or a powerful light ; the post-prostatic region especially must be carefully investigated both by touch and by sight ; if necessary, a 'caisson' speculum (see p. 456) should be passed down, in order to make sure that no other stone is present. If the patient is placed in the Trendelenburg position, the

upper part of the bladder does not project downwards as it does if the patient is lying flat, and if the prostatic pouch is very large, an assistant should push the base of the bladder forwards by means of a finger in the rectum.

In some cases the calculus is too large to extract through the ordinary incision, and then the latter must be extended or the stone must be broken up. Obviously, there are objections against enlarging the opening into the bladder beyond reasonable limits, and it is better to split up a very large stone. This may be done either by a powerful lithotrite, or by a hammer and chisel, the fragments being removed separately afterwards.

After-treatment.—If the urine is aseptic, the incision in the bladder may be sutured completely, as after rupture of that viscus (see p. 437), and the after-treatment is similar. If the urine is septic, the wound is treated as in tuberculous disease (see p. 455) and the bladder drained for about ten days. If there is any delay in the closure of the supra-pubic wound, a catheter should be tied in *per urethram*.

The removal of an encysted stone may be very difficult, even when the supra-pubic opening is large. When the communication between the pouch and the bladder is comparatively wide, it may be possible to dilate the opening and insinuate a scoop around the stone, and shell it out. If this cannot be done, the stone may first be fractured *in situ*, the stone being supported by an assistant's finger in the rectum. After all the fragments have been removed from the pouch, the bladder should be forcibly flushed out with boric lotion so as to ensure that no grit is left behind, otherwise a fresh stone may form.

When the prostate is much enlarged, it may be removed at the time of the operation for stone (see Chap. XXXIX.). If, however, the urine is foul and the patient not in a condition to stand the severe operation, supra-pubic drainage should be employed until the urine is healthy and the patient's strength is re-established, when the wound may be enlarged and the prostate enucleated. Unless the enlarged prostate is removed, a permanent supra-pubic fistula is very likely to remain, whilst fresh phosphatic stones will form in the prostatic pouch.

Perineal lithotomy.—This is a very rare operation nowadays, although formerly it was the only one employed. Almost the only cases in which perineal lithotomy is now used are those in which there is a stricture of the urethra, when a Syme's external urethrotomy may be combined with a *median lithotomy*. The operation may also be useful for calculi impacted in the urethra and for prostatic stone; it is simple, there is little bleeding, and little damage need be done to the soft parts if the stone is small. The patient is fully anæsthetised, the parts are shaved and disinfected, and a suitable staff with a median groove is passed into the bladder, any stricture being, if necessary, dilated beforehand. The patient is then secured in the lithotomy position and the staff is held by an assistant, who pulls its concavity well up against the arch of the

pubes, and also holds the scrotum out of the way. As a rule, the shaft of the staff should be vertical, although some surgeons prefer to have the handle somewhat depressed towards the abdomen, so that the convexity of its curve projects in the perineum. An incision, an inch and a half long, is made in the middle line of the perineum, extending downwards to about an inch in front of the anus. When the superficial structures have been cut through, the surgeon introduces his left forefinger into the wound and feels for the groove in the staff as it lies in the membranous urethra. The finger-nail is sunk into this, and the knife is slipped over the nail until its point is engaged in the groove, and the membranous and prostatic urethra are opened by pushing the knife along it; the latter should be held horizontal throughout. The left forefinger is then slipped out of the groove, but is kept in the wound, serving to press the rectum and soft parts backwards, and the knife is pushed on until the bladder is nearly reached, when it is withdrawn—taking care not to depress the handle in so doing, lest the rectum be damaged. A director is passed along the groove of the staff into the urethra, the staff is withdrawn, and the surgeon passes his finger into the urethra and through the neck of the bladder, which he dilates sufficiently to allow a small pair of forceps or a scoop to be passed. When the blades of the forceps are within the prostatic urethra, the finger is withdrawn and the closed forceps are slipped into the bladder; the stone is felt for, the blades are opened, and the calculus is seized. As a rule, the rush of urine through the wound when the finger is withdrawn, carries the stone into the neck of the bladder, so that there is no difficulty in seizing it at once. The stone should be grasped in its shortest diameter and, if this is not done at the first attempt, it should be manipulated until it lies lengthways, when it is withdrawn by gentle traction downwards and backwards so as to clear the arch of the pubes. If the stone is too large to be extracted in this way, the incision in the prostate may be enlarged by carrying a second incision outwards and downwards in the gland, and thus more room may be obtained. If the incision is kept strictly in the middle line there is no bleeding of any consequence. A stout rubber tube is passed through the perineal wound and tied into the bladder; oozing is stopped by packing gauze around it for some hours.

After-treatment.—The tube is removed in about four days, and the patient is allowed to pass urine naturally. At first, all the urine comes through the perineal opening, but in about ten days it begins to pass through the penile urethra, and the perineal wound closes in about four weeks. For the after-treatment of a case in which a stricture has been divided, see p. 385.

Lateral lithotomy has now fallen into such general disuse that it is not worth while to describe it. Anyone wishing to become familiar with it should refer to text-books on operative surgery.

CHAPTER XLVII.

TUMOURS OF THE BLADDER.

TUMOURS are not uncommon in the bladder ; they may be simple or malignant, and they may arise from any of the structures composing the bladder.

BENIGN TUMOURS.

Papilloma, or 'villous tumour of the bladder,' is common, and is generally benign, although it may grow on a malignant base. Two forms are met with: the *true villous tumour* of the bladder with long thread-like processes, and *sessile warty growths*. The villous tumours are composed of long filiform processes of connective tissue supporting blood-vessels and covered by epithelium. The growths are pedunculated, bleed with extreme readiness, and are often multiple. It is very common, on opening a bladder for a growth of this kind, to find one large villous mass with a number of smaller ones around. It would almost seem that they are locally infective, for, if a villous tumour is left unoperated upon, the bladder may become studded with little villous masses, and recurrence after operation is not at all uncommon. The fresh tumour does not always appear at the site of the original one, but may form in the neighbourhood, and be apparently a fresh development rather than a true recurrence.

The warty papillomata are not so common and are firmer and bleed less readily.

Fibromata, *myxomata*, *myomata*, and *angiomata* have been met with in the bladder ; the last of these are amongst the rarest, only two or three cases having been reported. We have had a case in which the left side of the bladder was occupied by an angiomatous growth, the only symptom being hæmorrhage, without any indication as to its true source, and so profuse that no satisfactory cystoscopic examination could be carried out. The diagnosis of a nævus of the bladder was made

before operation, partly by exclusion and partly because there were well-marked superficial nævi on the left thigh and elsewhere on the left side of the body.

Hæmaturia is often the only *symptom*, especially in the early stages. It is usually intermittent, lasting from a few hours up to some weeks, and is sometimes severe enough to produce profound anæmia. At other times there may be a mere discoloration of the urine with blood at intervals, lasting for a very short time. The hæmorrhage is generally most marked towards the close of the act of micturition, and is due to the contraction of the bladder wall upon the growth. The bleeding usually occurs without definite cause. Examination of the bladder with a sound or catheter, however carefully done, will generally give rise to a smart attack of hæmorrhage. As a rule, there is no pain in the early stages, and pain is often absent throughout; the same may be said with regard to other bladder symptoms—such as frequency of micturition. In the later stages, however, when the growth fills up the bladder to a considerable extent, there may be pain, frequency of micturition, and interference with the outflow, due to portions of the growth blocking the neck of the bladder. When micturition is markedly painful, cystitis has usually supervened.

TREATMENT.—When a benign growth of the bladder is diagnosed, the possibility of removing it must be considered, and, as a rule, the sooner the bladder is opened and the tumour removed the better. If there is much bleeding, there may be serious anæmia, and further cystitis is apt to occur and complicate operation considerably.

Palliative treatment.—While it is best to operate for simple tumours of the bladder, cases—especially of papillomata—occur in which operation is inadvisable, either on account of the diffuseness of the growths or for other reasons, and palliative measures must be adopted; where also several operations have already been performed, patients may refuse to submit to further operative procedures. In these cases, palliative measures must be adopted, and, in the case of papillomata, Herring has suggested that the bladder should be frequently irrigated with a solution of nitrate of silver not only to prevent bleeding, but to cause shrivelling of the growths. A ‘standard solution’ of nitrate of silver is made of the strength of one grain of the salt in a dram of distilled water slightly acidulated with nitric acid. Half a dram of the ‘standard solution’ in four ounces of distilled water at the body temperature is injected into the bladder daily as long as the bleeding persists. The strength of the injection may be increased very cautiously until one or two drams of the ‘standard solution’ are used. If cystitis is present, it must be treated on the ordinary lines. In some cases, the diathermic apparatus may be employed through a cystoscope.

Operative treatment.—For the removal of the tumour, the suprapubic operation should be performed (see p. 474). The bladder is opened

by the usual vertical incision in the great majority of cases ; occasionally, however, the cystoscope may reveal a growth in such a position that it will be dealt with more easily through a transverse than through a vertical opening (*vide infra*). The 'caisson' speculum (see p. 456) is useful for these cases, as by it the growth can be isolated, dried, and inspected in a good light, and its exact relations ascertained. The retractors illustrated in Fig. 123 are especially valuable in these cases, as they retract the walls of the bladder to a greater extent than the edges of the abdominal incision. The tumour is seized with forceps and cut away, together with the whole thickness of the mucous membrane beneath, and in the immediate vicinity of its base. The bleeding is stopped by temporary pressure with forceps, or by an electric cautery. Unless the elliptical wound thus made is very small, it is well to insert a stitch or two across its centre, and for this purpose the finest absorbable catgut should be employed in a fully curved intestinal needle, and the ends cut quite short. After the growth has been removed, the whole surface of the mucous membrane is gone over carefully with the help of the speculum in order to see whether any other growths are present ; if found, they should be removed in a similar manner. If the urine is aseptic, the bladder is then closed in the ordinary way (see p. 437), a drainage tube being inserted from the abdominal incision into the pre-vesical space. The after-treatment is described on p. 475. Recovery is rapid, and the patient may be up in three weeks.

Should there be free oozing, it is well to leave a tube in the bladder, otherwise blood-clots may cause distension of the bladder and leakage through the stitches. This tube is then fixed by a glass connection to another rubber tube, which dips under the surface of a bowl of carbolic lotion ; the tube may be left out in two or three days. A separate drainage tube should be inserted in the pre-vesical space. If the bladder cannot be closed tightly enough around the drainage tube, and urine escapes, an Irving's supra-pubic drainage apparatus may be employed (see p. 419), but it is more difficult to keep the urine aseptic with that arrangement.

When the tumour is very extensive, it may be difficult to work properly through the ordinary vertical incision, and a transverse incision through the abdominal wall from a point just above and internal to each internal abdominal ring will be more satisfactory. The recti are cut through transversely just above their insertion into the pubes, and the front of the bladder is thus freely exposed, and can be opened by a transverse incision also.

The result of these operations may be very satisfactory ; in some cases, however, fresh villous tumours form after a time, and the bladder may have to be opened repeatedly. It will often be found that the recurrence has not taken place on the site of the old growth if the latter has been effectually removed, but that fresh tumours have

appeared on other parts of the mucous membrane. Under these circumstances, Herring's injection method may be tried in the first instance before further operations are undertaken (see p. 478).

MALIGNANT TUMOURS.

Sarcoma of the bladder is rare. It is usually of the round-celled type, and occurs more often in young subjects than in adults.

Carcinoma of the bladder may be primary, or secondary to carcinoma of surrounding structures, such as the rectum, uterus, or prostate. The primary growth is a squamous-celled epithelioma, and its progress is usually slow; indeed, the history may extend over two to four years. Occasionally, the growth spreads much more rapidly, and the patient may die from repeated hæmorrhage or from septic decomposition of the urine.

The most common situation of the tumour is the neighbourhood of the trigone or the orifices of the ureters, and the growth soon infiltrates the bladder wall. Infection of the lumbar glands and secondary deposits in other organs are usually late in developing, and the patient may die from exhaustion due to prolonged hæmorrhage before infection of the glands has taken place.

Hæmorrhage generally appears later than in simple tumours, and is usually more persistent, although the blood is often smaller in quantity than in cases of villous tumour. Pain is a much more constant *symptom*, and may be due in part to the presence of the growth, but chiefly to the fact that cystitis sets in comparatively early. The pain may be very severe, and is referred to the supra-pubic region, the perineum, the bladder, and the thighs and loins. Micturition is very frequent, and the patient's condition is extremely miserable. The diagnosis will be made by a consideration of the characters of the hæmaturia, by microscopical examination of the urine—which often shows bladder epithelium in large quantity, or fragments of tumour—and by cystoscopic examination. Examination by a sound does not yield any definite information, and is apt to set up bleeding. Cystoscopic examination under these circumstances must be gently done, otherwise hæmorrhage may obscure the view. A time should be chosen when the urine is comparatively free from blood, and undue distension of the bladder must be avoided.

Useful information may also sometimes be obtained by the use of a metallic catheter with a large eye. The instrument is introduced into the bladder, the urine drawn off, three or four ounces of boric lotion injected, and the catheter used as a sound; a soft mass, which is not as definite or as hard as a stone, may be felt, and its outline may be made out between the catheter in the bladder and the finger in the rectum.

The finger is then suddenly removed from the end of the catheter and the fluid is allowed to escape rapidly, whilst the eye of the catheter is directed towards the trigone, which is the usual seat of these growths. A portion of the tumour may be washed into the eye of the catheter and may be pulled off as the instrument is removed; this can then be examined microscopically. When the introduction of a catheter or sound provokes free bleeding, the presence of a tumour is almost certain.

TREATMENT.—This is not very satisfactory, and very often resolves itself into attempts to keep the urine unirritating, combined with the administration of sedatives locally and generally.

The hæmorrhage may sometimes be kept under control by the use of gallic acid (gr. x), turpentine (℥xx), pil. plumbi cum opio (gr. x) or liquid extract of ergot (ʒj) internally. The last drug, however, must be used with extreme caution, and it is best to reserve it for cases in which the hæmorrhage is severe enough to threaten the patient's life, as, owing to the advanced age and exhausted condition of the subjects of malignant tumours of the bladder, serious physiological effects may be produced. The bladder may also be irrigated with a solution of adrenalin chloride (1 in 10,000), which may be injected into the bladder, and left there for a quarter of an hour. Should the hæmorrhage persist, or should there be severe cystitis which is beyond control, permanent drainage may be established above the pubes. An opening in this situation also enables the surgeon to investigate the condition of the bladder, and there is less risk of sepsis. Should the tumour be situated on the anterior surface of the bladder, however, the perineal route is the better.

Sometimes, however, the patient's condition is so bad that any of the foregoing operations are out of the question, and in that case supra-pubic drainage may be practised. The patient is placed under an anæsthetic, the bladder is distended with three or four ounces of fluid, a small median incision is made just above the symphysis pubis through the skin and superficial fascia, and then a suitably curved large trochar and canula is thrust through the anterior vesical wall backwards and somewhat downwards, just above the symphysis pubis. When the canula has entered the bladder, the trochar is withdrawn, and the canula is fixed in position by tapes and worn for about a week, so that the opening may become established; after that time it is removed, and a suitable india-rubber tube, provided with a shield and tube leading into a urinal, is substituted. This small operation is seldom accompanied by bad results, and may be performed with little or no shock to the patient, while it secures permanent and thorough drainage.

Operative treatment.—Operations for the removal of malignant growths of the bladder are very disappointing, although temporary freedom from symptoms is sometimes attained; this does not, however, usually last longer than a few months, and this is only what is to be expected from the difficulty of taking away a sufficient portion of

the wall of the bladder around the growth; occasionally, however, the tumour is small and superficial, and the prospects of recovery are better. In any case, it is advisable to perform a supra-pubic cystotomy when a malignant tumour has been diagnosed; if it is found impossible to remove it with any chance of success, supra-pubic drainage will afford relief to the patient's sufferings. The condition of a patient left to die of this affection is miserable in the extreme.

When supra-pubic cystotomy is performed as a *palliative* measure, the operation is done as described on p. 473. An india-rubber tube is tied in until the rest of the wound has healed, when a suitable gum-elastic or silver tube attached to tubing which passes into a portable urinal is substituted for it, and the patient can get about in comparative comfort and keep himself dry. As a rule, the bladder should be washed out by the patient himself daily with a little warm boric lotion, and both the tube in the bladder and that to the urinal should be in duplicate and should be boiled each time before it is used.

When the operation is done as part of a *radical* operation, the wider transverse incision into the bladder recommended on p. 479 will probably be required; all three incisions—namely, those through the skin, the abdominal wall, and the bladder—may be transverse, and excellent access is thus obtained.

Radical extirpation of malignant tumours of the bladder may involve removal of the whole or part of the organ. The excision of the actual tumour does not involve any severe operative difficulties, provided that the growth is still limited to the bladder; the great problem which presents itself is how to deal with the ureters.

1. *When the growth is limited to the anterior wall or fundus of the bladder*, there is no difficulty as regards the ureters, inasmuch as they are not involved, and the bladder can be readily repaired, and, although its capacity is diminished, it still serves as a reservoir for the urine.

When the growth is on the anterior wall, it is sufficient to excise the mass with a wide area—at least an inch—of bladder around it. The greater part of the wound in the bladder can then be closed by sutures, but it is well to put in a small tube in the centre of the incision to prevent tension on the stitches.

When the tumour is on the fundus of the bladder—that is to say, when it develops in that part of the bladder which is in relation with the peritoneum, the peritoneum should be freely opened and the intestines packed off so as to expose the field of operation thoroughly; the growth is then cut away as before, and the bladder repaired by inserting two rows of sutures, one picking up the muscular coat of the organ, and the other inverting the peritoneum by Lembert's method. It is well to drain the bladder by a drainage tube introduced through a separate incision in its wall just above the pubes, and also to introduce a tube into the peritoneal cavity down to the bladder in case leakage should

occur. Partial excision of the bladder on these lines is sometimes a very satisfactory operation, and a permanent cure may be obtained, the patient merely suffering from slight frequency of micturition.

2. *When the growth involves the base of the bladder and the opening of the ureter*, the problem is more difficult. The widest access possible should be obtained, and there need be no hesitation in opening the peritoneal cavity freely, provided that the intestines are carefully packed off and the abdomen drained afterwards.

If only one ureter is affected, a partial excision may still be possible. The growth should be separated all round the papilla of the ureter, and the wall of the bladder divided until the tumour is attached merely by the ureter. With a little manipulation, it is possible to draw about two inches of the ureter into the wound; the latter is then sewn up with a double layer of sutures, leaving room for the ureter to pass. The growth is now removed by cutting the ureter across inside the bladder, and the open end of the ureter is slit up and then allowed to slip back into its fascial tunnel (which consists of a tube of fibrous tissue and pelvic fascia); a uretero-vesical fistula forms, which conveys the urine satisfactorily. If this method is not feasible, the ureter can be grafted into the fundus of the bladder (see p. 540). In these operations not only should the bladder be drained by a tube inserted above the pubes, but a tube should be left in the peritoneal cavity leading down to the wound in the bladder and packed round with gauze if leakage is likely to occur.

3. *If the whole of the base of the bladder is affected* and it is decided to attempt radical treatment, the bladder must be completely extirpated. This is an operation of considerable magnitude, and has been seldom performed, so that it is hardly possible as yet to say exactly what method will ultimately prove to be the best. The best results, on the whole, seem to have been obtained by a preliminary double nephrostomy or ureterostomy, the patient wearing some form of urinal on each loin, but the condition of the patient under such circumstances is very miserable, and it seems much better to leave him alone. The usual transverse incision is made above the pubes, and the abdomen is opened. The peritoneum is then divided around the fundus of the bladder, dissected up from the sides of the pelvis, and the edges sewn up so as to isolate the bladder from the general peritoneal cavity. The bladder is then freed, together with any fat, glands, and fascia in the neighbourhood; in the male, the prostate and seminal vesicles are usually taken away also. Lastly, the urethra is divided and the bladder taken away, a large tube being inserted to carry off any discharge.

If a preliminary nephrostomy is not desired, the ureters may be variously treated; it has been suggested—

1. To let them lie at the bottom of the wound and thus establish a supra-pubic fistula.

2. To bring them up to the surface of the wound.
3. To graft them into some part of the intestine, or into the vagina in the female.

All these suggestions seem to be equally undesirable, with the possible exception of grafting the ureters into the bowel, and even in that case pyelitis is practically certain to follow in a very short time. There does not therefore seem to be much scope for radical treatment in extensive malignant disease of the bladder.

SECTION IV.—AFFECTIONS OF THE KIDNEY AND URETER.

CHAPTER XLVIII.

ANATOMY OF THE KIDNEY AND URETER.

ANATOMY OF THE KIDNEY.

Surface anatomy.—According to Morris ('Surgical Diseases of the Kidney and Ureter'), a horizontal line through the umbilicus passes below the lower limit of each kidney (see Fig. 128); a vertical line carried upwards to the costal margin from the middle of Poupart's ligament has one-third of the kidney to its outer side, and two-thirds to its inner side.

On the posterior surface of the body the boundaries of the kidney are as follows:—

1. A line parallel to and one inch from the spinous processes extending from the lower edge of the tip of the eleventh dorsal spine to the level of the lower edge of that of the third lumbar (see Fig. 129).
2. A line carried from the top of this line outwards at right angles to it for $2\frac{3}{4}$ inches.
3. A line carried outwards from the lower end of the vertical line for $2\frac{3}{4}$ inches.
4. A line parallel to the first and connecting the outer extremities of the second and third.

The upper two-thirds of the normal kidney are under cover of the ribs, but the lower third descends below them. The right kidney is generally lower than the left by something like half an inch.

In the hilum of the kidney lie the renal artery, the renal vein, the ureter, lymphatic vessels running to the median lumbar glands, and nerves derived from the renal plexus and the lesser splanchnic nerve. In the pelvis of the kidney the relation of the main structures is, from above downwards, artery, vein, and ureter, and from before backwards,

vein, artery, and ureter. The vein runs almost horizontally, and is a little lower and shorter on the right side than on the left. On the left side it passes in front of the aorta, below the superior mesenteric artery and above the third part of the duodenum. The left renal vein is joined by the left spermatic vein. The renal artery is large, and arises from the side of the aorta a little below the superior mesenteric artery. It divides into three chief branches before it reaches the hilum, and this must be borne in mind when the pedicle of the kidney is ligatured close to the organ itself. One of these branches runs behind the pelvis of the kidney.

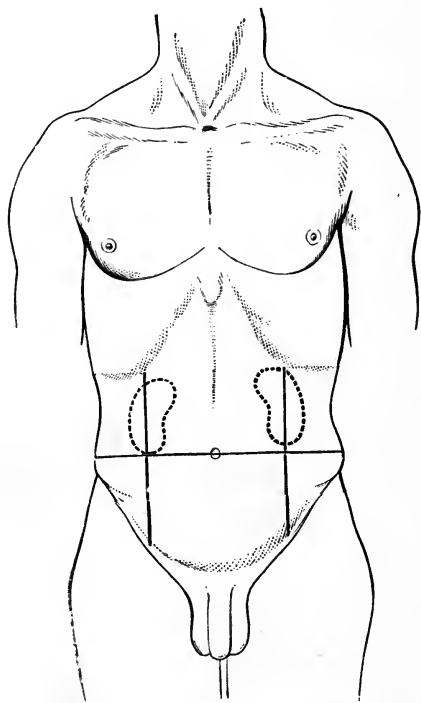


FIG. 128.—THE SURFACE-MARKING OF THE KIDNEY FROM THE FRONT. (Morris.)

The kidney is embedded in a mass of fat, called the tunica adiposa, which is thick and plentiful posteriorly and on the convex border of the kidney, but very thin in front; it is also thick below the lower end of the kidney. This fat is delicate, of a canary-yellow colour, and only loosely connected with the fibrous capsule of the gland, unless inflammation has occurred. The kidney, with the tunica adiposa, is surrounded by a fascia—the peri-nephric fascia—which is sometimes mistaken for the peritoneum. This fascia is deficient along the inner and lower borders of the kidney; hence the mobility of the kidney in the inward and downward direction.

The right *supra-renal body* rests upon the upper pole of the right kidney; the left is in relation with the upper part of the inner border and slightly with the anterior surface and the upper pole. It is separated by areolar tissue from the kidney, but on the left side the supra-renal vein joins the renal vein, and the relation is more intimate than on the right, where the supra-renal vein goes direct to the vena cava.

Relations of the anterior surface of the kidney.—On the *right side*, above, the peritoneum is in contact with the kidney, and in front of it is the under-surface of the right lobe of the liver. About the middle, the second part of the duodenum overlaps the kidney, and lower down and to the right, the hepatic flexure of the colon lies in front of it.

Below, in the angle of the hepatic flexure, is a coil of small intestine. On the *left side* above, the anterior surface of the kidney is separated from the fundus of the stomach by the splenic artery. It then comes in contact with the pancreas, and along its outer border it is in relation with the commencement of the descending colon, with a coil of small intestine to the inner side. The outer border of the kidney in its upper two-thirds is in contact with the spleen; in the lower third, with the descending colon. The peritoneum is intact with it at the upper and lower ends and along the upper part of its outer border.

Relations of the posterior surface of the kidney.—

Posteriorly, the upper part of the kidney rests upon the diaphragm, while below, it lies on the internal layer of the posterior aponeurosis of the transversalis muscle, which separates it from the quadratus lumborum. Internally and inferiorly, it rests upon the psoas muscle. The upper edge of the kidney corresponds to the space between the eleventh and twelfth ribs, and the lower edge is nearly on a level with the middle of the third lumbar spine. The ligamentum arcuatum externum is also in relation with the kidney just below the diaphragm, and this ligament may render the removal of the organ difficult and may require division. A little

below the middle of the kidney, the last dorsal nerve runs outwards and downwards, and lower still are the ilio-hypogastric and the ilio-inguinal nerves; the close relation of these nerves to the kidney probably explains some of the referred pains in cases of renal disease.

From without inwards, the following structures lie between the kidney and the surface in the lumbar region, looked at from behind: skin, superficial fascia, deep fascia, the aponeurosis and fibres of the latissimus dorsi, the serratus posticus inferior, the posterior layer of the aponeurosis of the transversalis muscle, and, farther out, the fleshy origins of the external and internal oblique muscles. Behind the kidney at the upper part are the whole of the twelfth rib, except its head, the external intercostal muscle between it and the eleventh rib, and about

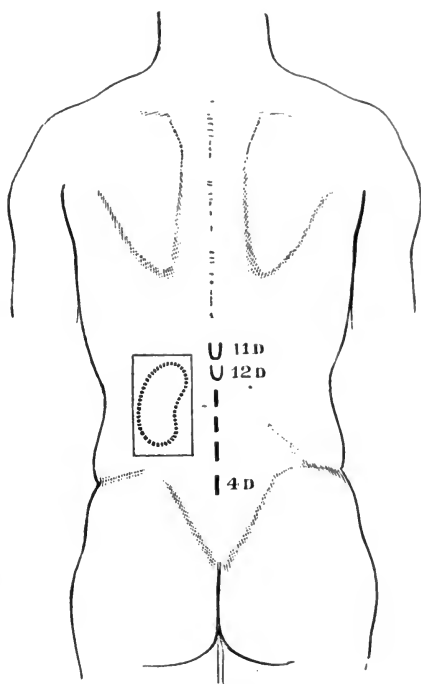


FIG. 129.—THE SURFACE-MARKING OF THE KIDNEY ON THE LOIN. (Morris.)

two inches of the latter near its angle. Internally, comes the erector spinæ, beneath and to the outer side of which is the middle layer of the posterior aponeurosis of the transversalis abdominis, and deeper, the quadratus lumborum. In front of the quadratus is the anterior layer of the posterior aponeurosis of the transversalis muscle, with the last dorsal, ilio-hypogastric, and ilio-inguinal nerves, and the outer part of the psoas muscle. In front of this again is the peri-nephric fascia, and inside that the adipose tunic of the kidney.

It may be necessary to resect a portion of the last rib in order to obtain space for removal of the kidney, and care must then be taken not to injure the pleura which descends as far as the neck of the twelfth rib; further forward, the twelfth rib is generally below the pleura which runs from its neck to the eleventh rib. It may, however, descend even below the neck of the twelfth rib. When the last rib is rudimentary, the pleura may run from the level of the last dorsal vertebra to the eleventh rib, or in some cases only from the eleventh dorsal vertebra to the eleventh rib.

ANATOMY OF THE URETER.

The ureter is about twelve inches long, and the left is slightly longer than the right. It commences to the inner side of and somewhat above the lower extremity of the kidney, opposite the body of the second lumbar vertebra. On the posterior surface of the trunk this corresponds to a point rather more than an inch and a half from the middle line on a level with the upper border of the second lumbar spine, while on the anterior surface it is the same distance from the middle line on a line drawn round the body about one inch below the central point between the upper border of the manubrium sterni and the symphysis pubis. The ureter descends on the surface of the psoas muscle to the brim of the pelvis, where it crosses the lower end of the common or the upper part of the external iliac arteries (see Fig. 130). At the brim of the pelvis, the position of the ureter is indicated in front by a point corresponding to the junction of the upper and middle thirds of the line indicating the course of the common and external iliac arteries. This line is drawn from a point half an inch below and to the left of the umbilicus to a point midway between the anterior superior spine of the ilium and the symphysis pubis. The ureter then turns backwards and outwards along the side of the pelvis to a point about an inch in front of the spine of the ischium; thence it passes forwards on the upper surface of the levator ani muscle to its termination in the wall of the bladder. In its course it presents three constrictions and two intermediate dilatations. The first constriction is situated about two and a half inches below the hilum of the kidney, which is the narrowest part of the ureter. The second constriction is at the point at which it passes

over the pelvic brim, and the third is at its termination in the bladder wall.

Relations of the ureter.—The *abdominal portion* lies on the psoas muscle and crosses the genito-crural nerve about half-way between the commencement of the ureter and the brim of the pelvis. Anteriorly, its upper part is in direct contact and intimately connected with the peritoneum. The spermatic or ovarian arteries pass between the lower part of the ureter and the peritoneum, and are closely connected with both. On the right side the upper part is covered by the third part of the duodenum, while, lower down, the right colic and ileo-colic arteries, the terminal part of the ileum, and the vermiform appendix pass in front of it. On the left side the ureter is crossed anteriorly by the left colic and sigmoid branches of the inferior mesenteric artery and by the jejunum, while the inner border of the colon, if distended, may overlap it. Lower down, the ureter is crossed by the commencement of the rectum.

The *pelvic relations* are important, owing to the depth at which the ureter is situated and the difficulty in getting at it. In the male, the first part of the ureter, after crossing the pelvic brim, passes downwards and backwards along the side of the pelvis to a point about an inch in front of the spine of the ischium. It lies immediately in front of the internal iliac

artery, and externally is in contact with the pelvic fascia covering the obturator internus; it crosses the obliterated hypogastric artery and the obturator vessels and nerve. Internally, it is covered by peritoneum which separates it from the sigmoid colon on the left side, and from the terminal portion of the ileum on the right. In the second part of its course in the pelvis, it runs forwards and inwards, beneath the peritoneum upon the upper surface of the levator ani; it lies against the side

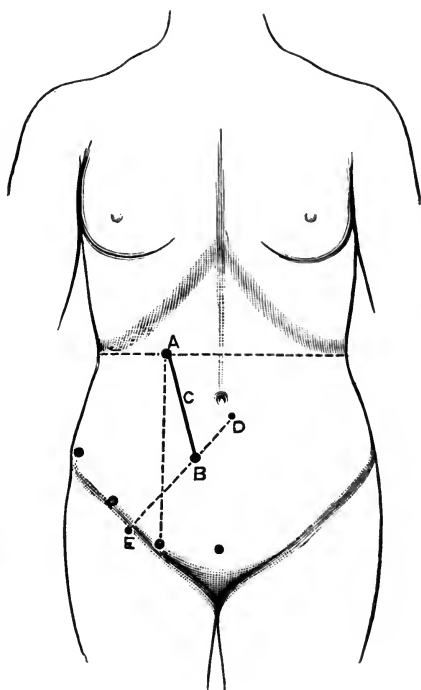


FIG. 130.—THE SURFACE-MARKING OF THE ABDOMINAL PORTION OF THE URETER. A, commencement of the ureter. B, ureter at the pelvic brim. C, line of abdominal portion of the ureter. D, bifurcation of the aorta. E, midpoint between the symphysis pubis and the anterior superior iliac spine. The horizontal dotted line is the level of the tips of the twelfth ribs; the vertical one is drawn upwards from the junction of the inner with the middle third of Poupart's ligament. (Morris.)

and base of the bladder below the level of the obliterated hypogastric artery. Before it reaches the bladder it comes into relation with the vas deferens, which passes between it and the side of the bladder, and it enters the bladder wall immediately in front of the upper end of the vesicula seminalis.

In the female, the pelvic portion of the ureter may also be looked on as consisting of two parts—an upper and a lower. The upper part passes, as in the male, from the brim of the pelvis downwards and backwards on the lateral wall to a point about an inch in front of the ischial spine. The second part runs forwards and inwards on the upper surface of the levator ani muscle and beneath the base of the broad ligament. It is accompanied by a dense plexus of veins from the lower part of the uterine and the upper part of the vaginal plexuses. It passes below the uterine artery, crossing the side of the cervix uteri and above and in front of the lateral fornix of the vagina; it enters the base of the bladder in the undistended state at a point three-quarters of an inch from the middle line and a quarter of an inch below the anterior fornix.

In the bladder in both sexes its course is obliquely downwards and inwards for about three-quarters of an inch, and it lies nearer the inner than the outer surface of the bladder, the muscular coat being posterior to it throughout nearly its whole length. The vesical orifice is slit-like, with its long axis directed backwards and outwards; it is frequently situated on the summit of a small elevation from three-quarters to one inch distant from its fellow and about the same distance from the orifice of the urethra. Between the orifices, an elevation is seen on the inner surface of the bladder formed partly by a band of the longitudinal muscular fibres of the ureter and partly by the muscular fibres of the bladder. This ridge forms the base of the trigone.

The arteries which supply the ureter are branches of the renal, the spermatic or ovarian, and the vesical arteries, and they anastomose freely in the wall of the ureter. The lymphatics are numerous, and the lower ones terminate in the iliac, and the upper ones in the lumbar, glands. The nerves are derived from the renal, the spermatic or ovarian, and the vesical plexuses.

CHAPTER XLIX.

METHODS OF EXAMINATION OF THE KIDNEY.

Inspection of the region of the kidney shows nothing unless the organ is enlarged or there is peri-nephric inflammation. When the patient lies on his back, a much enlarged kidney may give rise to a prominence in front, which becomes more evident during complete expiration, but the organ must be very large before this is noticeable. In peri-nephric inflammation, fixation of the muscles on the affected side during respiration may be evident, and when there is suppuration in this situation, there may be obvious bulging and œdema in the loin.

Palpation.—It is difficult to feel the normal kidney, and at most only the lower end of it comes down between the fingers. When the kidney is being palpated, the patient should lie on his back with the legs drawn up and the shoulders slightly raised, and one hand should be placed beneath the loin just below the last rib, so that the patient rests upon it; the kidney can be pushed forward by this hand. The other hand is placed flat over the front of the renal region, and presses firmly backwards and upwards under the lower ribs. The manipulations must be gentle, and must be practised with the flat hand, otherwise the muscles will contract and nothing will be felt. During the examination, the patient should in the first instance breathe quietly and, subsequently, as deeply as possible. The kidney descends during inspiration, and if it is pushed forward by the hand behind, while at the same time the hand in front presses backwards, the organ will be felt if it is enlarged, and any abnormality about the lower end may be detected. Further, if the hand in front is pressed well inwards and upwards during deep inspiration, the entire kidney, if movable, may be caught and fixed below the ribs. This may not be possible at the first inspiration, but if the kidney is movable, it will ultimately come down if steady pressure is kept up throughout a series of deep respirations.

Additional information may often be obtained by altering the position of the patient. An enlarged mobile kidney may descend and become more noticeable when the patient is in the erect position, and even

one that is movable, but not enlarged, may thus be felt more easily. Moreover, by turning the patient over on one side, a kidney may be felt which otherwise would escape observation. When the kidney is very movable, and the patient is put in the genu-pectoral position, the kidney will fall on to the hand placed over the front of the abdomen.

Some information may be gained by eliciting the presence of tenderness, even though there be no enlargement, and sometimes the examination may set up hæmaturia. Unless the result of the examination be thoroughly conclusive, a further investigation should be carried out under an anæsthetic; the anæsthetic thoroughly relaxes the abdominal walls, and is especially valuable when the kidney is tender, the patient timid, or the abdominal walls rigid. Examination of the kidney under an anæsthetic is, however, only of value when the kidney is enlarged. A mobile kidney does not descend freely when the patient is under an anæsthetic, as he rarely breathes deeply enough.

Percussion is of more value as indicating that any given swelling is situated in the renal region, than in determining the condition of the kidney itself. As the colon lies in front of the kidney, a renal enlargement will always give rise to dullness in the flank with the colon resonance in front of it, whereas the dullness due to splenic and other enlargements is generally in front of the bowel. There should be no resonance between the kidney and the vertebral column.

Radiography.—The X-rays have been employed extensively and with success in demonstrating the presence of stone in the kidney. All varieties of stone, however, are not equally opaque to the rays, and a stone consisting of pure uric acid—especially in a fat person—may escape notice, even with the most modern apparatus. In suitable subjects, and in skilled hands, radiograms may also give much information as to the size of the kidney and variations in its position.

Exploratory incision.—In some cases, this may be practised with advantage, but it should not be done unless there is reason to believe that benefit will ensue; it is usually reserved for cases in which the presence of a stone in the renal pelvis is suspected, but cannot be demonstrated by the X-rays. Occasionally, no stone is found, and there is nothing abnormal to the naked eye, and yet the pain and neuralgia from which the patient suffers may disappear after the exploration.

The question of an exploratory incision to determine the condition of the other kidney may arise in cases of tuberculous kidney when there is a question of removing the affected one. The method, however, is unreliable if the exploration is made through the abdomen, and the only certain way of gaining trustworthy information by exploration would be to cut down upon each kidney in succession from behind. This is a serious addition to the shock of the operation, and it has even happened that the operation has been followed by fatal suppression of urine when the kidney that has been so explored has turned out to be

extensively diseased. The method has now fallen into complete disuse, more especially since other methods of ascertaining the activity of the renal function have been so perfected of recent years as to render it unnecessary, even if it were safe.

For the methods of employing the cystoscope, practising pyelography, and estimating the renal function, see Chap. L., for which we are indebted to the kindness of Mr. Thomson Walker.

Examination of the urine often gives much information both as to whether the seat of disease is the kidney or the bladder, and as to which kidney is affected.

Hæmaturia.—When of renal origin, the blood is usually intimately mixed with the urine, and varies in colour from a smoky tint to a deep porter-like brown. In rupture of the kidney, however, and in cases of growth in which blood is poured out in large quantities, the tint may be much brighter, but in these cases, the presence of clots in the urine, which may take the form of the calices or pelvis of the kidney, or of the ureter, indicates that the blood comes from those parts; the expulsion of these clots is frequently accompanied by renal colic.

Free renal hæmaturia of spontaneous origin is most likely to be due to a growth. When it only occurs after exertion, and is moderate in quantity, it may be due to a calculus. In renal tuberculosis, the hæmaturia is generally slight, does not depend on exertion, and is generally accompanied by a considerable amount of pus.

The diagnosis between hæmorrhage from the bladder and that from the kidney is nowadays generally made by means of the cystoscope, by the aid of which the blood is seen issuing in a reddish stream from the ureteral orifice, when it comes from the kidney. When the cystoscope is not available, the diagnosis is facilitated by washing out the bladder; when the blood comes from the kidney, the last washing will be clear and the urine in the bladder will remain so until fresh blood comes down the ureter. When, however, the hæmorrhage comes from the bladder, it will be practically impossible to render the fluid free from the admixture of blood, however frequently the washing is repeated. In free hæmaturia of bladder origin, it may be difficult to render the fluid in the bladder clear enough to enable a distinct view to be obtained with the cystoscope.

Further information will be obtained by microscopical examination showing the presence of pieces of tumour or renal casts, parasites—such as distoma hæmatobium, hooklets, etc.

Pyuria.—When pus is present in the urine, it is difficult to be sure that it is of renal origin, unless the pus is seen coming from the ureter in a thick muddy stream, or unless clinical symptoms point to the kidney as its source. The presence of renal epithelium will aid the diagnosis; catheterisation of the ureters will render it certain.

Determination of the side affected.—In most cases, there is no difficulty in coming to a correct conclusion as to the particular kidney

involved. The following points are of use: Pain—especially the characteristic kidney pain—shooting down the ureter and into the groin, when constant and referred to one side only, practically points to that side as the seat of disease. It is stated that pain may be referred to the side opposite to that affected, but it is very doubtful whether the whole pain of the patient is ever so referred, and indeed whether pain is even really present on a side where the kidney is healthy. Further evidence is obtained by palpation of the kidney; in some cases the presence of an increased amount of pus or blood in the bladder, after palpation of a particular kidney, may indicate which side is diseased. In cases of doubt, examination of the ureters and the orifices by the cystoscope should always be undertaken, and is of the greatest help.

CHAPTER L.

CYSTOSCOPY, CYSTOSCOPIC EXAMINATION OF THE URETERS, PYELOGRAPHY, AND EXAMINATION OF THE RENAL FUNCTION.

By J. W. THOMSON WALKER, M.B., F.R.C.S.

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SINCE the introduction of the electric cystoscope by Nitze in 1880, the instrument has been gradually perfected, and at the present time cystoscopy has become the essential method of diagnosis in the majority of urinary diseases.

There are few diseases of the bladder in which useful information cannot be gained by cystoscopy: there are many in which a correct diagnosis cannot be made without its use. The sound, digital exploration of the bladder, and exploratory cystotomy have been superseded by the cystoscope. One great advantage of cystoscopy is that the walls of the bladder are stretched by the distending medium during the inspection, and every part of the viscus can be viewed; while in other methods, such as cystotomy, the wall is collapsed and may be contracted, and the mucous membrane is thrown into folds, which may conceal some pathological condition.

In diseases of the kidney, cystoscopy gives information that may not be obtainable by other methods. Localisation of disease to the kidney by inspection of the ureteric orifices, in cases in which no symptoms are present to point to one kidney or even to the kidney at all, is an important instance.

Such cases as unilateral renal hæmaturia without other symptoms, or unilateral renal tuberculosis with only symptoms of bladder irritation, may be quoted as typical examples of the value of the cystoscope in localising disease to the kidney. A diagnosis of the nature of the disease of the kidney may also be made by inspection of the ureteric orifice in cases in which the diagnosis is otherwise obscure.

By catheterisation of the ureters, the functional value and presence or absence of disease of each kidney is ascertained, and this is especially important in regard to the supposed healthy kidney when nephrectomy is proposed. Further, the position of an obstruction in the ureter in hydronephrosis can be ascertained by passing a ureteric catheter, and the relation of a doubtful radiographic shadow to the ureter is demonstrated by the passage of a bougie, opaque to the X-rays. Finally, the introduction of opaque fluids into the pelvis of the kidney, followed by radiography (pyelography), has proved of immense value in the early diagnosis of dilatation of the kidney, while lavage of the pelvis of the kidney in chronic pyelitis has become, in expert hands, a recognised method of treatment.

METHODS OF CYSTOSCOPY.

There are two methods of cystoscopy—the direct and the indirect.

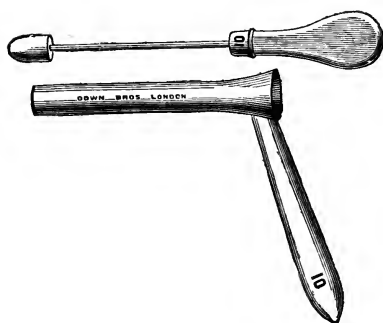


FIG. 131.—KELLY'S FEMALE BLADDER SPECULUM.

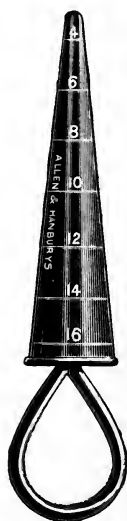


FIG. 132.—KELLY'S FEMALE URETHRA DILATOR. The numbers engraved on the dilator correspond with the sizes of the specula.

DIRECT CYSTOSCOPY.

This method was perfected by Kelly, and has been used and modified by Luys, Braasch, and others.

Kelly's specula (see Fig. 131) are metal cylinders, $3\frac{1}{2}$ inches long and of a uniform diameter throughout. There is a funnel-shaped expansion at the outer end, and a handle 3 inches long is attached to the funnel. The specula are made in various sizes from 5 to 20, each number repre-

senting the diameters in millimetres. Each instrument has an obturator, which is used during introduction. A dilator (see Fig. 132) is used to enlarge the orifice of the urethra, and an evacuator to remove the urine which accumulates in the bladder during a prolonged examination. The evacuator consists of a rubber exhausting-bulb and 14 inches of fine rubber tubing, and, at the bladder end, a small hollow perforated metal ball.

The lower bowel is emptied, and immediately before the examination, the bladder is emptied in a sitting or standing position. General

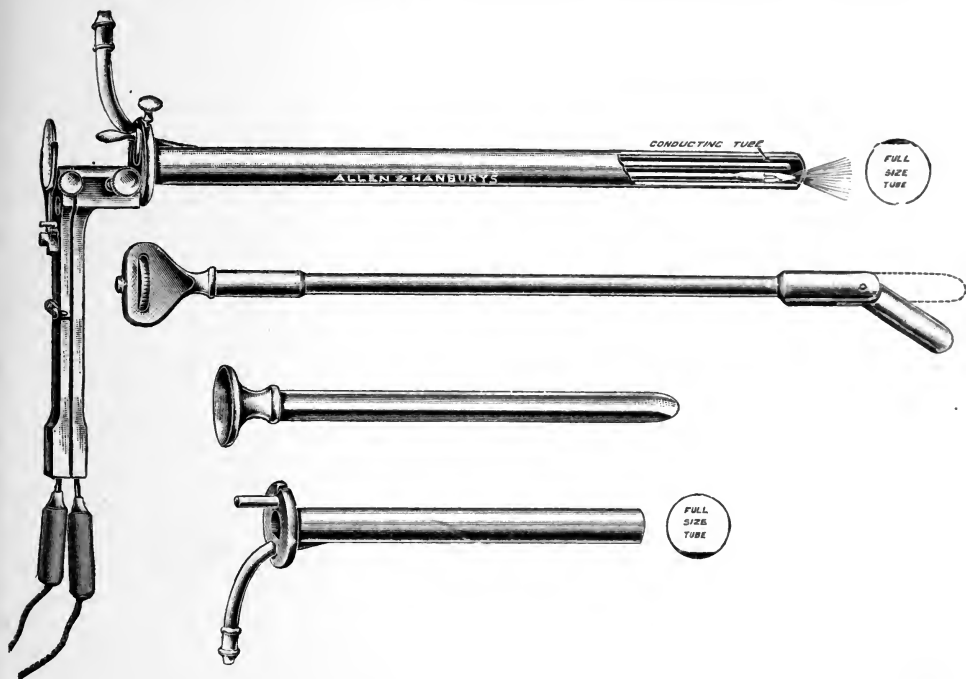


FIG. 133.—LUYS'S DIRECT CYSTOSCOPE. The principle is similar to that of the urethroscope, shown in Fig. 95, except that here there is a suction apparatus to remove the urine. The two lower figures are the tube and obturator for the female; the two upper, those for the male.

anæsthesia is necessary in nervous individuals. Local anæsthesia is obtained by cocaine introduced on pledgets of wool.

Two positions are used : (a) the elevated dorsal, (b) the knee-chest.

(a) The elevated dorsal position is less trying to the patient, but it is only of service in thin patients, and the atmospheric distension of the bladder is not so good. The bladder of stout patients will rarely distend at all in this position. The buttocks are raised 10 or 12 inches above the table level, the speculum is introduced, the obturator withdrawn and the atmospheric pressure distends the bladder.

(b) In the knee-chest position, the patient kneels, with the knees slightly separated, close to the end of the table and allows the back to curve in, with the buttocks well raised. If an anæsthetic is required, the patient may be held by assistants, or a slinging apparatus may be used. The speculum is introduced, the obturator withdrawn, and light projected through it from a forehead mirror. After an examination, the bladder is emptied by introducing a catheter, and gently lowering the patient to the horizontal.

Kelly's method is only applicable to the female, and the position is an exhausting and embarrassing one. Luys has modified this method, and uses it in the male also. His instrument (see Fig. 133) consists in a metal tube of 10 cm. for the female, and 18 cm. for the male, on the floor of which is a fine tunnel leading to a small tube, which a rubber tube attaches to a vacuum bottle; this prevents the accumulation of urine in the bladder. The plunger that closes the tube during introduction is straight in the instrument for the female, and angled in that for the male.

The patient is placed in the Trendelenburg position, under local or general anæsthesia. It is not always possible to obtain complete distension of the bladder, and there may be folds and depressions. An area at the apex and the anterior wall are inaccessible to examination. As a method of examination, direct cystoscopy is inferior to indirect. With the tube, a small area of bladder wall is seen, and the instrument must approach it closely in order to get a good view. With the prismatic cystoscope, on the other hand, an extensive field is displayed, and a broad bird's-eye view can be obtained. The advantage of the direct or open method is the facility it presents for topical applications in cystitis, for operation in small papillomata, and for the removal of foreign bodies from the bladder.

INDIRECT CYSTOSCOPY.

The indirect method is that most commonly in use, and the most widely applicable.

The simplest form of cystoscope consists of a telescope and lighting apparatus combined. Before using this instrument, it is necessary to pass a catheter and distend the bladder with fluid. The cystoscope is then introduced, and, when the inspection is finished, it is removed and the catheter is again passed in order to empty the bladder. To obviate this, the modern irrigation cystoscope is designed. The irrigation cystoscope consists of an outer tube, which acts as a catheter and carries the lighting apparatus—a small metal filament lamp set at an angle to the shaft of the tube. At the proximal end of the tube is a valve, which prevents the fluid escaping. In the Ringleb pattern of cystoscope, the valve is a trap-door, kept shut by springs in a compartment at the end of

the tube. This has the disadvantage of collecting pus and débris, and requires very careful cleaning. In the author's irrigating cystoscope (see Fig. 134), the outer catheter tube can be boiled, and the valve which closes the distal end acts by a spring placed outside the lumen and may also be used as a turncock. The telescope is separate, and is a long tube containing a number of lenses and a prism at the distal end. The telescope is made by Zeiss, and gives a very sharp, magnified, erect image.

The advantage of the irrigating cystoscope is that only one introduction of the instrument is required, and, should it be necessary to wash out the bladder during the cystoscopy on account of clouding of the medium, this can be done by withdrawing the telescope without moving the outer tube from the urethra.

The cystoscope can be cleaned with ether-soap and carbolic lotion (1 in 20), or biniodide of mercury solution (1 in 1,000), and care should be

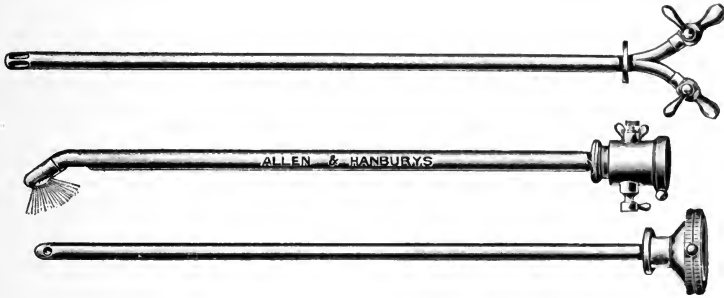


FIG. 134.—THOMSON WALKER'S IRRIGATING CYSTOSCOPE. The instrument is fully described in the text.

taken to flush the catheter tube with the antiseptic. If the author's pattern is used; the catheter tube may be boiled for two or three minutes, taking care that the lamp is well screwed on to prevent water getting between the lamp and the metal contact which carries the electric current. The telescope is cleaned with ether-soap and antiseptic. It is not boiled.

The electric current may be derived from accumulators, dry cells, or from the main electric supply. For metal filament lamps, dry cells ($4\frac{1}{2}$ volts) can be obtained. They are small, light; and inexpensive. For carbon filament lamps; a higher voltage is required, and larger accumulators or batteries are necessary. In taking the current from the main; a rheostat is required, and an additional finely graded small rheostat can be affixed to the contact of the larger rheostat to reduce the current to the required voltage.

METHOD OF PERFORMING INDIRECT CYSTOSCOPY.—The cystoscope is sterilised, and is placed in a tall jar containing carbolic lotion (1 in 40). The lighting apparatus is carefully

tested. The patient either lies on a couch with a sand-pillow beneath the pelvis or sits in a special chair with the knees and hips flexed and the thighs widely apart, or may be placed in the lithotomy position. A general anæsthetic is very rarely required; it may be necessary when the bladder and urethra are intensely sensitive; or the patient is highly nervous; or in young unmarried women.

Local anæsthesia should be produced in males, but it is unnecessary in the short female urethra.

The urethra is anæsthetised by instilling 15 or 20 minims of a 4 per cent. novocaine solution or 1 per cent. cocaine solution, or by a combination of alypin and suprarenin (tablets of alypin, $\frac{1}{8}$ grain; suprarenin boric, 2 minims of a 1 in 1,000 solution). The fluid is introduced into the prostatic urethra by means of a Guyon catheter and syringe, or it is placed in the anterior urethra with a glass pipette and rubber teat and massaged back into the prostatic portion. When the bladder is very irritable, washing with a solution of antipyrin (5 per cent.) may soothe it. After allowing time for the anæsthetic to take effect, the catheter portion of the irrigating cystoscope, well lubricated with glycerine, is passed, and the bladder emptied by inserting the hollow plug which opens the valve at the end of the tube.

If the urine is clear, 8 or 10 ounces of warm boric lotion are introduced by means of a bladder syringe or from an irrigator. I prefer a bladder syringe, as with it the exact amount that has been introduced into the bladder may be readily measured and the amount of intravesical pressure can be gauged. The best syringes are made of glass, with an asbestos or a metal plunger, and hold from 4 to 8 ounces of fluid. The fluid should be slightly above body temperature, and is introduced slowly. Spasm of the bladder may be caused by rapid introduction or too cold fluid. In cystitis, the capacity of the bladder is reduced and, if the cystitis is acute, the viscus may not hold more than one or two ounces. Sometimes a general anæsthetic may be required on account of the extreme sensitiveness of the bladder. A little more fluid can be introduced, but the bladder reflex is not abolished under general anæsthesia; and there is a quickening and deepening of respiration when a sensitive inflamed bladder is distended to its full capacity, which may amount only to a few ounces.

If the urine is cloudy with pus and débris or blood, the bladder must be washed by repeated syringefuls of fluid, and the surgeon is not content until the fluid is absolutely clear when examined in a glass vessel against the light.

If there is difficulty in obtaining a clear medium, a double-way metal catheter, which is supplied with the cystoscope, should be used—one of the arms being connected with an irrigator, while the other allows the fluid to escape into a vessel. Care should be taken, when the patient is unconscious, that the intake of fluid into the bladder does not exceed

the outgoing stream, otherwise the bladder will become distended with fluid although apparently being emptied. When bleeding is going on in the bladder, great care should be taken not to over-distend the bladder, as the hæmorrhage may be increased by this means. The most difficult type of hæmorrhage to control, for the purpose of cystoscopy, is a slight constant oozing from a tuberculous ulcer or a malignant growth. A very weak solution of silver nitrate (1 in 8,000) is sometimes effective in stopping the bleeding, or half a dram of adrenalin (1 in 1,000) may be run in through the catheter, retained in the bladder for two minutes, and then allowed to run out. In subsequently distending the bladder, great care must be taken to avoid over-distending it and thus restarting the bleeding.

Having obtained a clear returning fluid, the bladder is carefully filled with 8 or 10 ounces of warm boric lotion, the hollow plug removed, and the telescope inserted. The electrical contact is then fixed into the cystoscope, the current switched on, and the cystoscopy commenced.

CYSTOSCOPIC APPEARANCES OF THE NORMAL BLADDER.—The interior of the bladder should be systematically examined. The window is first turned directly downwards, and the direction will be seen by observing the position of the small knob on the rim of the ocular end of the telescope.

The trigone comes into view. The mucous membrane of this part is darker in colour and coarser in texture than the rest of the bladder, and the blood-vessels, which are larger and more numerous than elsewhere, spread out from the urethra fanwise. The inter-ureteric ridge or bar of Mercier will be seen as a transverse ridge, but it may only be marked by the difference in colour between the darker trigone and the lighter surrounding mucous membrane. Following this ridge outwards, first on one side and then on the other, it will be found to rise and become more prominent, and is then lost in the bladder wall. On the prominent part of the ridge is a small red slit, the ureteric orifice, and this will come into view when the window is turned one-eighth of a circle to one or other side. From the ureteric orifice, or from its immediate neighbourhood, a comparatively large blood-vessel passes out and splits into two branches, or there are two vessels issuing from the ureter, which pass outwards and backwards. These vessels may serve as a guide to the orifice when it is difficult to find.

A method of finding the ureteric orifice, which may be useful to the beginner, is chromo-cystoscopy. This is very rarely required by an experienced cystoscopist, and only when advanced disease of the bladder has caused distortion of the bladder base and obliterated the natural features of the trigone. Thirty minims of a solution (4 per cent.) of indigo-carmin are injected into the muscles of the thigh, and in about twenty minutes the urine issuing from the ureteric orifice is deeply coloured with the blue dye and has the appearance of puffs of dark smoke.

The normal ureter takes a great variety of appearances, which can only be learned by constant practice in cystoscopy. On watching the ureter, the ridge to its outer side is seen to thicken, and then the part of the ridge on each side of the ureter becomes drawn up and rigid. The ureteric orifice gapes, and emits a jet of fluid. In the normal state, this is clear and is only seen as a swirl of fluid at the orifice and across the trigone. The number of ureteric contractions varies. Usually, a contraction occurs once in about eight or ten seconds, but, under the influence of the light, or for other reasons, it may occur only at intervals of one or two minutes, or even longer in quite healthy individuals. When there is polyuria or some cause for irritation in the ureter, the contraction may be rapidly repeated with increased vigour.

The posterior or postero-superior wall, the lateral walls, and the anterior wall of the bladder, are then examined in turn.

The mucous membrane has a yellowish sandy colour, and in the normal state is light-reflecting. In the fully distended bladder, a slight ridging may be observed from the prominence of muscular bands, but this is never marked in the normal bladder. In a partly distended bladder, the mucous membrane is thrown into folds and appears darker in colour. Occasionally, a peculiar honeycomb appearance is presented by the mucosa of the partly distended bladder.

The blood-vessels are few in number, and appear at irregular intervals through the mucous membrane and split up into fine twigs. Larger vessels in the deeper layer of the mucous membrane are frequently seen as ill-defined blue tracks. At the highest part of the bladder, an air-bubble, introduced by the catheter, is invariably seen. It serves to mark the apex of the bladder.

In order to see the upper part of the bladder clearly, the instrument is pushed in and the eyepiece depressed. The parts of the bladder which are most difficult to examine are the posterior wall near the apex and the anterior wall, the latter appearing somewhat in perspective, as it rises almost vertically from the urethral orifice.

Pulsation may be observed in the lateral walls or base, and is especially evident when a tumour is present in the interior of the bladder. It is due to the close proximity of the internal iliac artery.

Vermicular waves may be seen sweeping across the postero-superior wall, and are due to peristaltic movements of intestine in the recto-vesical pouch in the male or above the uterus in the female.

After examining the bladder, the cystoscope is withdrawn a little, so that the window is partly in the urethra. The mucous membrane at the internal meatus is thus examined; it forms a dull-red curtain occupying part of the field, and becomes more translucent as the edge is approached. The urethral margin is slightly concave, except when the window of the cystoscope looks directly backwards; it then has a slight convexity.

CYSTOSCOPIC APPEARANCES IN DISEASE OF THE BLADDER AND KIDNEYS.—Only a short note of the abnormal conditions found in the bladder can be given.

In the hypertrophied bladder of urethral obstruction (enlarged prostate or stricture), the bladder is trabeculated. The mucous membrane is raised up in ridges, which are usually thick, fleshy, and interlaced. The trabeculation affects the whole bladder, and the trigone becomes involved, so that there may be difficulty in tracing the inter-ureteric bar and in finding the ureteric orifice. When sacculation of the bladder is present, depressions appear between the fleshy trabeculæ, and pockets, varying in depth, are formed. These differ from congenital diverticula in being shallow and oval, round or irregular in shape, and in their number. In diseases of the spinal cord (especially tabes), a very pronounced trabeculation of the bladder is found. This is distinguished from hypertrophic trabeculation in the ridges, being thin and sharp, and sometimes very long, and the trigone is not affected. This condition is, I believe, an atrophy, not a hypertrophy.

Congenital diverticula are single or multiple; frequently there is a large single diverticulum. The most common situation is behind or outside the ureteric orifices. The orifice is round—rarely oval—and appears as a solitary opening. Around the orifice, the mucous membrane is frequently thrown into radiating folds, and there may be some trabeculation in the immediate neighbourhood. The rest of the bladder is usually normal.

Cystitis is found in many grades, and may be general or localised to one part. General cystitis is much less frequent than might be supposed. The most frequent condition is cystitis which involves the trigone or the base of the bladder, and has followed upon some urethral inflammation. Or it may be more marked on one side of the base and surround the ureteric orifice. Patchy cystitis may be observed, when there are scattered areas of cystitis over the whole mucous membrane.

In general acute cystitis, cystoscopy is rarely advisable.

In cystitis, the light-reflecting power of the bladder is diminished, and the mucosa is dull and light-absorbing. In the earliest stage, the vessels are engorged, and appear greatly increased in size and in numbers, and anastomose freely. Later, the outline of the vessels becomes indistinct, and the mucous membrane presents a woolly, reddened appearance. Then the vessels entirely disappear, and in acute inflammation the mucous membrane is light red, and has lost all its fine texture and vessels. Flakes of muco-pus adhere to the surface, and shreds of partly detached epithelium are seen. When there are patches of cystitis, the different stages can be traced from the periphery towards the centre.

In chronic cystitis, the mucous membrane is dull red and opaque,

and the blood-vessels cannot be seen. In old-standing cases, it may be slaty grey.

Ulceration may be superficial, and a whitish layer of muco-pus frequently adheres to the surface. Ulceration frequently takes place along the most prominent part of the folds and ridges, into which the mucous membrane is thrown by contraction of the bladder muscle. Deeper ulceration is rare, and takes the form of an irregular ulcer or a solitary ulcer, or multiple rounded ulcers with thick heaped-up edges. Phosphatic deposit may powder the ulcerated surface with white or form large phosphatic masses.

Bullous cystitis is present when there are groups or widespread development of closely set vesicles like bullæ. The condition may develop in any case of acute cystitis, and is frequently evanescent. In hæmorrhagic cystitis, there are numerous hæmorrhages into the mucosa. Glandular cystitis consists of scattered yellowish vesicles, said to be due to occluded glands. The amount of vascular reaction around these vesicles may be very slight. In villous cystitis, numerous small villi develop and resemble a sessile papilloma.

In tuberculous cystitis, the lesions may not differ from those of the early stage of cystitis due to other causes. Typical lesions may, however, develop. Small yellow tubercles are found rarely in a miliary form; more frequently they occur in groups, which may be scattered over the bladder, or may lie in the immediate neighbourhood of a ureter, or surround a deep tuberculous ulcer. Occasionally, a large yellow caseous mass is found in very chronic cases. These tubercles may break down, leaving a small ulcer, which extends by further breaking down of surrounding tubercles, so that a group of small ulcers coalesces into a large tuberculous ulcer. In this, the edges are thin, irregular, and overhanging. There is frequently evidence of healing at one part and spreading at another.

The tuberculous lesions are usually grouped around a ureter, but may be widespread and affect the whole bladder.

Bilharzia occurs in the bladder in the form of groups of yellow nodules, closely resembling tubercles, but usually of larger size, and sometimes set on ridges of inflamed mucous membrane. In another form, there is the development of irregular masses of granulation tissue, and, eventually, a form of villous tumour develops.

Foreign bodies and calculi are readily seen by means of the cystoscope. A calculus of very large size may be difficult to see, as the movements of the instrument are hampered by it. Calculi in sacculi, and behind an enlarged prostate, are readily recognised. A large calculus may, however, occupy a diverticulum and show no evidence of its presence on inspection of the small round opening by the cystoscope.

Papilloma, or villous tumour, forms a very beautiful cystoscopic picture. These tumours may be single or multiple, and are most frequently

found in the neighbourhood of the ureteric orifices. They may, however, be found in any part of the bladder wall; they most frequently resemble a well-formed bath-sponge. The villi of which they are composed may be long, and the tumour has the appearance of a mass of seaweed. On close inspection, the villi are flat and resemble closely massed leaves, or have rounded knob-like ends. Fine vessels can be traced in the villi.

Papillomata may be pedunculated, or have a very short base, or may be sessile.

The presence of a long pedicle can only be ascertained by noting marked changes in the position of the growth in subsequent examinations. A thick fleshy pedicle is sometimes observed, and is compatible with a simple type of papilloma.

Malignant growths are found in a number of different forms. A rare type resembles a simple papilloma.

Nodular growths are the most frequent form. They vary greatly in size. There may be a rounded or oval nodule the size of a hazel-nut, or a large mass the size of a tangerine orange, projecting into the bladder. These may be sessile, but the base is sometimes contracted, and there may even be a definite pedicle. The surface is smooth or finely nodular, and is sometimes powdered with phosphates or necrotic in parts. Other growths have a softer, fleshy appearance, and are more irregular in outline.

Another type of malignant growth infiltrates the bladder wall without forming any prominent projection into the cavity. The mucous membrane is thick and raised in irregular nodules. This type may have a depressed ulcerated centre.

The mucous membrane round a malignant growth may show ridges or puckers or thickening from infiltration, or there may be œdematous finger-like processes, all denoting infiltration of the deeper layers of the wall.

Cystitis is present in a large proportion of malignant growths. It usually arises spontaneously, and is frequently the condition for which the patient seeks advice—the growth being discovered on cystoscopy.

Examination of the ureteric orifices gives information in regard to disease of the kidney and ureter.

The method of finding the orifice, its appearance in health, and the observation of the efflux, have already been described.

The normal efflux is clear, and there is a ureteric contraction and a jet of urine every eight or ten seconds. The interval and quantity may be reduced in healthy individuals, so that an efflux is observed only at long intervals (half-minute to two minutes, or longer). This probably results from nervous influences due to the cystoscopy.

There is no efflux and no contraction when the kidney is congenitally absent or has been removed, or when there is a ureteric fistula and the ureter has been completely severed, or when there is complete obstruction of the ureter. When there is a ureteric fistula, and the duct is not

completely cut across, contractions—but no efflux—are observed at the ureteric orifice. In complete blockage of the ureter, high up, as in closed hydronephrosis; a feeble contraction may be observed at the ureteric orifice at long intervals. The efflux is more copious when polyuria is in progress; and in such cases the increased volume can be distinguished at the ureteric orifice; ureteric contraction occurs also with greater frequency. Such polyuria may result from diuretics, or it is observed in such surgical diseases as early tuberculosis, advanced interstitial nephritis, from long-continued obstruction (stricture, enlarged prostate), and occasionally in calculus.

The presence of an irritant such as calculus in the ureter, or of acute or subacute inflammation of the renal pelvis or ureter (as in bacillus coli, or other infections), causes an increased frequency of contraction of the ureter, and each contraction is more vigorous. In some cases of acute ureteritis, each contraction seen at the ureteric orifice amounts to a spasm.

The observation of a purulent efflux depends upon the quantity of pus present in the urine.

A trace of pus in the urine, sufficient to produce a slightly cloudy urine in a test-tube, cannot be distinguished at the ureteric orifice unless there are solid flakes in the urine.

A decidedly cloudy urine, containing pus and débris, momentarily clouds the cystoscopic view as it shoots from the ureter, and then the medium clears again as the cloud diffuses. A urine which shows a distinct murky jet at the ureteric meatus will appear much more opaque when collected in a glass jar.

In advanced suppurative disease of the kidney, when only a small quantity of urine is secreted, a worm of semi-solid, waxy-looking pus is seen to issue from the ureter, roll down the side of the ureteric ridge, and break off, to be succeeded after an interval by another pipe of pus.

Blood in the urine can be detected at the ureteric orifice when the urine is tinged with colour, and is very evident when severe renal hæmaturia is in progress. In severe hæmorrhage, a clot may be observed projecting from the ureter as a dark, brownish-black, irregular mass, which may project and recede at each ureteric contraction and allow a trickle of light-red blood to pass alongside.

Changes at the ureteric orifice form an important indication of renal disease.

The absence of the ureteric orifice indicates that the kidney is absent on that side. A ureteric orifice and a ureter patent for several inches may, however, be present when the corresponding kidney is absent or completely atrophic.

A double ureteric orifice indicates the presence of a double ureter. The orifices are usually situated close alongside each other on a broad ureteric ridge.

In infections of the kidney and pelvis, the ureteric orifice shows evidence of the inflammation. This varies according to the severity and duration of the infection. In slighter cases, there may be only a little thickening and elongation of the lips, or there is a halo of cystitis around the ureteric orifice, and the lips are thickened and puffy in appearance. In severe cases, the area around the ureteric orifice is bright scarlet, and the ureteric ridge is raised, thick, and thrown into innumerable folds and ridges of bright red, somewhat œdematous, mucous membrane, while the orifice is buried among folds. In old-standing inflammation affecting the ureter, the orifice is open, round, and rigid, and contractions are absent or fail to close it completely.

In tuberculosis of the kidney, great varieties of appearances may be observed. There may be slight thickening and elongation of the lips, deposit of yellow tubercles on the lips or around the orifice, and ulceration of the lips, later on, spreading round the orifice and concealing it. Œdema around the orifice, forming a mass of vesicles in which the orifice is buried, is sometimes present. In the late stage of chronic tuberculosis of the kidney and ureter, the orifice is displaced outwards and backwards, and appears as a tunnel-like opening, into which the muscular ridge of this branch of the trigone is seen to disappear. The ureter in such cases is thick, hard, and contracted.

In stone in the ureter, the appearances may be those of infection, already described. After an attack of renal colic, a splash of hæmorrhage may be observed at the orifice. Large masses of œdematous mucous membrane may surround the orifice in some cases of ureteric calculus. A calculus may project from the orifice as a white or brown mass, or, when the surface is crystalline, it scintillates in the electric light.

The urethral orifice is examined by withdrawing the cystoscope, so that the window is partly in the urethra. A red curtain appears to have been drawn partly over the field of vision. The free margin of this is straight or slightly concave, and is semi-translucent.

In simple enlargement of the prostate, the prostatic substance is more opaque and projects into the bladder, so that the margin is convex. When a single lobe projects into the bladder, the rounded mass can be seen; when there are two intravesical lobes, the orifice appears to be V-shaped. On the surface of the intravesical portion, small translucent cysts and large tortuous veins are frequently seen.

In malignant disease of the prostate, the margin is frequently irregular and the substance densely opaque.

CATHETERISATION OF THE URETERS.

This method has completely superseded intravesical separation of the urines. A special catheterising cystoscope (see Fig. 135) is required. This is similar to the irrigating cystoscope, with the addition of a tunnel

along the upper surface of the shaft. The tunnel opens at the ocular end in a tube provided with a small hole, through which the catheter passes, and there is a stopcock to permit the escape of fluid when the catheter is not in position. At the distal end of the cystoscope, the tunnel opens just short of the prism window, and there is a small elevator, raised by a screw, at the ocular end. A double or a single tunnel may be provided. The double tunnel makes a larger instrument, which is rather more difficult to pass.

The patient is prepared as for simple cystoscopy. The catheterising cystoscope is introduced, and the telescope placed in position. The ureteric catheter, carefully rendered aseptic, is placed on a sterilised towel. It is lubricated with glycerine, and passed along the tunnel of the cystoscope. It is necessary that the telescope should be in place

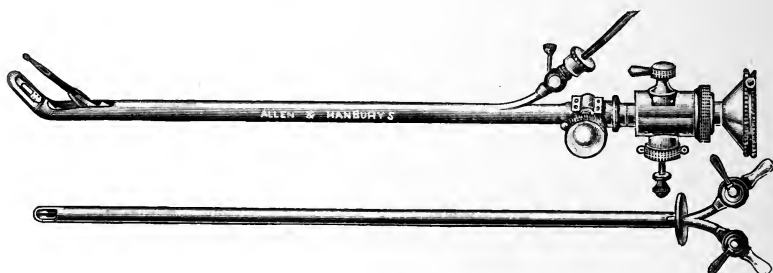


FIG. 135.—THOMSON WALKER'S URETHRAL CATHETERISING CYSTOSCOPE. The lower figure is the two-way irrigating tube.

when the catheter is passed through the cystoscope, as it forms the floor of the tunnel. The window of the cystoscope is now turned downwards and the inter-ureteric bar comes into view. Following this outwards, by turning the cystoscope on its axis, the opening of the ureter comes into view. The ocular end of the cystoscope is now raised and drawn towards the side opposite to the ureter which is to be catheterised. By this manœuvre, the window of the instrument approaches close to the ureteric orifice.

The catheter is now pushed in until its point is well in view of the window. Its axis is still, however, too near that of the shaft of the cystoscope to permit of its engaging in the ureteric orifice. A touch of the screw at the base of the cystoscope raises the little elevator at the distal end of the tunnel, and the point of the catheter rises away from the cystoscope and is easily slipped into the ureteric orifice. Care should be taken not to raise the elevator too far, as the catheter does not run so easily when it is erect.

The use of the elevator is reserved for the final stage, the preliminary manœuvring being done with the whole cystoscope.

When the point of the catheter has entered the ureteric orifice, it is

seen raising up the mucous membrane of the intra-mural portion of the ureter. The cystoscope is held firmly in position, and the catheter pushed gently on. When the point is fairly in the ureter, the elevating-screw should be lowered and the catheter runs more easily. My catheters are marked in different colours each half-inch, and there is a single red ring at 6 inches, a double red ring at 12 inches, and three red rings at 18 inches. It is thus possible to tell exactly in what part of the ureter the point of the catheter lies and when it meets obstruction (see Fig. 136).

The point lies a little above the brim of the pelvis when the 6-inch mark disappears; and has entered the pelvis when the 12-inch mark passes into the ureteric orifice.

If it is intended to catheterise both ureters, a double catheterising cystoscope may be used, or the single catheter cystoscope may be withdrawn, leaving the catheter in position, reloaded and reintroduced. I

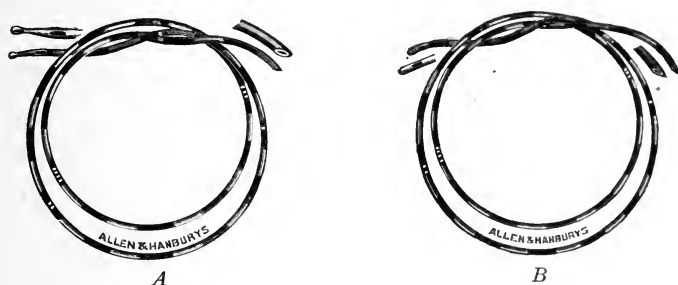


FIG. 136.—THOMSON WALKER'S GRADUATED URETERAL CATHETERS. *A*, shows the probe-ended ones; *B*, the blunt-nosed ones.

use a single-barrel catheter cystoscope, as it is seldom necessary to catheterise both ureters simultaneously, and the single-barrel instrument is of smaller calibre, and, therefore, more easily introduced in the male.

The difficulties of catheterising the ureters are; firstly, those of cystoscopy, and none but a skilled cystoscopist should attempt this delicate procedure. An enlarged prostate may render catheterisation of the ureter impracticable, and a tuberculous prostate may cause difficulty by interfering with the freedom of movement of the cystoscope. When cystitis is present, the bladder may not tolerate sufficient distension; but, to those practised in the operation, two or three ounces capacity will suffice.* There may be difficulty in reaching a ureter which opens in the back of a ridge, or of finding the opening in an ulcerated area. The ureteric orifice may be too rigid, or it may be naturally too small to admit even a fine-pointed catheter. The catheter may be arrested an inch, or one and a half inches, from the orifice in a healthy ureter. This may be due to contraction of the levator ani muscle, or to an over-distended or under-distended bladder.

The introduction of instruments into the ureter has many applications in diagnosis.

1. Sounding the ureter.—In obstruction of the ureter, it is possible to ascertain the exact position of the obstruction. When a stone is impacted in the ureter, the catheter will be felt to hesitate, and may either pass on or be arrested. On withdrawing the catheter, when it has passed the calculus, it may be felt to drag or even grate. Kelly has introduced wax-tipped bougies, which show scratch-marks caused by rough calculi. The X-rays have, however, simplified the diagnosis.

The passage of a bougie opaque to the X-rays is an important adjunct to the radiography of ureteric calculus. When a doubtful radiographic shadow lies in, or near, the line of the ureter, an opaque bougie is passed up the ureter and another plate obtained. The bougie may be arrested at the calculus, or it may pass alongside it, and the relation of the bougie to the shadow will be seen.

2. Examination of the urines of the two kidneys.—This is one of the greatest advances of the modern surgery of the kidneys.

It has two chief applications. When disease of the kidney is known to be present, and there are no symptoms pointing to one kidney, and inspection of the ureteric orifices does not give definite information, catheterisation of the ureters is performed, and each urine examined microscopically, chemically, and bacteriologically.

Early tuberculosis of the kidney may be taken as an example when there is a trace of pus, tubercle bacilli, and, perhaps, a history of hæmaturia, and both ureteric orifices appear normal. Catheterisation of the ureters allows of the necessary examination of the separate urines.

The second chief use of ureteral catheterisation is the examination of the second kidney when nephrectomy is proposed. Examination of the unblended urine of the second kidney gives information in regard to the presence of a second kidney, of the presence or absence of disease in the kidney, and of the functional power of the organ. Tuberculosis of the kidney may again be taken as an example. The kidney is known to be tuberculous from symptoms, the presence of tubercle bacilli in the urine, and the discovery of signs of tuberculous disease at the ureteric orifice. Nephrectomy is the recognised treatment if the second kidney is healthy. This information is obtained by examining the urine of the second kidney drawn by the ureteric catheter.

The procedure is as follows:—

Half an hour before the examination, a large draught of Contrexéville water is given. A general anæsthetic is not necessary, unless the patient is nervous or the bladder intensely sensitive.

The bladder is very carefully washed, and catheterisation of the ureter of the apparently healthy kidney is performed. The catheter is passed into the renal pelvis, a blunt-nosed catheter being used if it will pass.

The cystoscope is withdrawn, leaving the catheter in position. A urethral catheter is passed, and the bladder emptied and the catheter tied in. The ureteric catheter is fixed to the thigh of the side to which it belongs by means of a strip of adhesive plaster. Between the thigh, a sterilised bottle, labelled right and another labelled left, are placed, the neck of each being covered with several layers of sterilised gauze, and through these the catheters are inserted into the bottles. The knees may be held together by pinning a broadly folded towel round them. The patient is made as comfortable as possible.

One of the following tests for the renal function is now used:—

1. Phloridzin test.—A subcutaneous injection of 5 milligrammes of phloridzin is given. Sugar is detected in the urine in a normal kidney in from fifteen to twenty minutes, and continues for two to two and a half hours. An injection of 5 milligrammes of phloridzin will normally produce from 1 to 2 grammes of glucose. In healthy individuals, the elimination of glucose by the two kidneys is equal and parallel. When disease of the kidney is present, the appearance of glucose is delayed, and the amount produced by this organ is diminished. Glucose is completely absent if there is advanced disease of the kidney. For this test, the catheter is retained for two or two and a half hours; the urine is tested for sugar several times during the first three-quarters of an hour to ascertain when the elimination commences, and at the end of two hours to see if the elimination has ceased.

The total quantity of glucose present in the urine is estimated.

The functional power of the kidney is judged by the presence or absence of delay in commencement of elimination and the total quantity of sugar eliminated.

2. The Phenol-sulphone phthalein test.—This consists in injecting a solution of phenol-sulphone phthalein hypodermically, and observing the time of appearance and the percentage eliminated during the first three hours. A diuretic is given half an hour before commencing the test.

One cubic centimetre of phenol-sulphone phthalein solution (6 mgr.) is injected hypodermically.

A few drops of sodium hydrate solution (25 per cent.) are placed in two test-tubes, and the urine from the catheter allowed to drop into these. When the drug commences to pass, a definite pink colour appears, and, as the quantity increases, this darkens to a well-marked magenta.

The quantity of the drug eliminated is estimated by the use of a colorimeter ('The Universal Colorimeter,' *Lancet*, 1912, vol. i. p. 438).

In normal cases, the colouring material is said to appear in from five to ten minutes; 40 to 60 per cent. of the drug is excreted in the first hour, 20 to 25 per cent. in the second hour, and 60 to 85 per cent. in the whole of the first two hours.

3. The Indigo-carmin test.—A tablet containing 0.16 gramme of

indigo-carmin is dissolved in water, and injected hypodermically. The urine becomes tinged in ten or twelve minutes, and rapidly becomes green and then blue, the highest point of excretion being reached half or three-quarters of an hour after injection. Excretion continues in small quantities for about twelve hours.

About 25 per cent. of the drug is excreted by the kidneys. The quantity is usually roughly estimated by the eye, but the percentage may be obtained by means of a colorimeter. Delay in the appearance, and a feeble staining of the urine, are signs of disease.

EXAMINATION OF THE URINE OF THE SECOND KIDNEY.

The urine is collected for two or two and a half hours, and sufficient quantity is usually obtained during this time. Should the flow from the catheter cease, the lumen may be gently syringed with about half a dram of warm boric lotion, by means of a ureteric catheter syringe (see Fig. 137).



FIG. 137.—SYRINGE FOR USE WITH A URETERIC CATHETER.

A cup of hot tea or other diuretic may also be given. If there is pain from the presence of the catheter, it will be relieved by a hot fomentation applied to the abdomen.

When sufficient urine has collected, the catheters are withdrawn, and the patient given a dose of urotropin and a tumbler of hot Contrexéville water. The patient should remain in bed for twenty-four or thirty-six hours after the examination.

The specimen is examined as follows :—

The quantity, specific gravity, and a quantitative estimation of the urea are made, and a microscopical examination of the centrifugised deposit.

The total quantity of sugar is estimated if the phloridzin test is used, and the percentage of phenol-sulphone phthalein, or of indigo-carmin, if these tests have been employed.

Finally, a bacteriological test is made, and the urine is examined for tubercle bacilli, guinea-pigs being injected if necessary.

PYELOGRAPHY.

This consists in the introduction into the renal pelvis of a fluid opaque to the X-rays, and obtaining a radiogram. By this means the size and outline of the renal pelvis and calyces are demonstrated.

The method is of use in detecting hydronephrosis in the early stage before the kidney has been destroyed, and thus enabling the surgeon to

perform a conservative operation. It is also invaluable in showing the relation of the kidney to obscure abdominal tumours, and to radiographic shadows supposed to be urinary calculi. It has also been applied to other diseases of the kidney, but the practical use in these is less striking.

Collargol is the drug best suited for the purpose. It is used in a 10 per cent. or even a 20 per cent. solution.

The method is as follows :—

The collargol solution is heated to a little above the body temperature. The barrel of a glass syringe of 40 c.c. capacity is used, and the needle fits into the ureteric catheter. A ureteric catheter opaque to the X-rays is used.

No general anæsthetic is used, and no morphine should be administered before the operation.

The ureteric catheter is passed up to the pelvis of the kidney in the manner already described, and the contents allowed to run off. The barrel of the syringe is filled with warm collargol solution, and the needle is inserted into the end of the catheter and raised to the full extent, which the free end of the catheter permits (usually about 6 inches). The collargol solution slowly settles down in the syringe and fills the renal pelvis.

At the first sign of discomfort in the kidney, the instillation is stopped, the catheter plugged, and a radiogram taken. The plug is then removed and the collargol solution allowed to run off, the pelvis being washed out with boric lotion. By this method, very beautiful pictures of the renal pelvis and calyces are obtained. Early hydronephrosis is indicated by clubbing of the calyces and by reduction of the angle between the lowest calyx and the upper end of the ureter. The position of the obstruction can also be shown, and the author has been able by this method to make an accurate diagnosis of an abnormal renal vessel causing hydronephrosis when the kidney could not be felt on palpation. The position of the kidney in obscure abdominal tumours has also been shown in cases of hydatid cyst, peri-renal sarcoma, and displaced and adherent liver, as well as the relation of the renal pelvis and calyces to a shadow which was found to be thrown by a gall-stone. For further details of the method and its use, the reader is referred to the following articles by the author: *Lancet*, 1911, June 17; 'Medical Society's Transactions,' vol. xxxv., 1912; 'Annals of Surgery,' 1913.

The use of this method is attended with some degree of risk in unskilful and unpractised hands. Rupture of the renal pelvis and injection of the tubules of the kidney have been recorded when the fluid has been injected under considerable force. The utmost gentleness and delicacy of manipulation are imperative, and no anæsthetic should be administered.

LAVAGE OF THE RENAL PELVIS.

In a few cases of intractable pyelitis, lavage of the renal pelvis has been followed by cure. A solution of boric acid, nitrate of silver (1 in 8,000), or protargol (1 in 1,000) may be used.

The ureteric catheter is passed, and the contents of the pelvis run off. The solution is instilled very slowly by means of a ureteric catheter syringe, about one half-dram being used at a time, and the fluid then allowed to flow out. The lavage may be repeated once a week.

CHAPTER LI.

CONGENITAL ABNORMALITIES OF THE KIDNEY AND URETER: NEPHROPTOSIS.

ALTHOUGH the *abnormalities of the kidney* are not amenable to treatment they may be met with during operations and may puzzle the operator. For example, the two kidneys may be fused together to form a '*horse-shoe kidney*,' and this may be situated as low down as the sacro-iliac synchondrosis, the promontory of the sacrum, or even lower. *Displacements* of one kidney or of both may also occur, and the kidney may vary in form or size and may be markedly lobulated. There may be only a *single kidney* present. *Congenital cystic disease* of the kidney is usually bilateral and is not then amenable to treatment.

Abnormalities of the ureter are not uncommon. The hilum may be absent, the renal pelvis may be double, the ureter may be double at its upper part—though rarely throughout its whole length—or it may terminate in the urethra, the seminal vesicles, the vagina, or even the rectum. Congenital prolapse of the lower end of the ureter into the bladder is also met with; it may also be acquired as the result of stenosis of the ureteral orifice. The ureter may be compressed by an abnormal renal artery, or congenital strictures may occur in it; these conditions may be accompanied by hydronephrosis or atrophy of the kidney, and are referred to on p. 580.

NEPHROPTOSIS OR MOVABLE KIDNEY.

The normal kidney is somewhat movable on respiration in the vertical direction, but it should not descend to a lower level when the patient assumes the upright position. When it does so, or when the kidney comes so low down that it can be grasped and fixed between the examiner's hands the condition is abnormal.

A movable kidney may be either congenital or acquired. In very rare cases there is an exceptionally long renal pedicle, and this and the

kidney are completely surrounded by peritoneum, so that there is a distinct mesonephron ; in the great majority of cases, however, there is no true mesonephron, although the pedicle becomes elongated and the peritoneum invests the kidney more completely than usual.

The affection is at least six times as common in women as in men. The right kidney is more frequently affected than the left, and this has been explained by the fact that the lower edge of the liver helps to retain the right kidney in position, and that when the latter is pressed downwards as a result of tight lacing or a sudden strain, it is, so to speak, dislocated from under the edge of the liver and does not return to its proper position. Movable kidney is often found in patients who are very thin and have recently lost flesh, and those who hold that the fatty capsule is one of the chief agents in keeping the kidney in position look upon the absorption of the fat in the capsule of the kidney which occurs in connection with general emaciation as one of the chief causes of undue mobility. Mobility of the kidney may follow pregnancy, partly as the result of the distension of the abdomen and the subsequent laxity of its walls, and possibly partly from violent contractions of the abdominal wall during delivery. In many instances, no doubt, the immediate cause of the mobility—or, at any rate, of the patient noticing it—is some injury, such as a blow or some sudden violent exertion, and in these cases it is generally assumed that some dislocation of the kidney has occurred.

The mobility of the kidney may occur alone or may be associated with other troubles, especially that known as *enteroptosis* (see Vol. IV. Chap. XXXII). Enteroptosis is often present to a marked degree, and in these cases the abnormal descent of the kidney appears to be only a part of the general laxity of the abdominal viscera. The association of movable kidney with enteroptosis is of great importance in connection with treatment, because many of the symptoms may be due to the condition of the general abdominal contents rather than to the mobility of the kidney, and an operation which merely fixes the latter may in no way relieve them. The frequency with which these conditions are associated is variously estimated by different writers. Glénard, who first described enteroptosis, holds that practically all cases of mobility of the kidney are associated with it. Other authors, on the contrary, while admitting the frequent conjunction of the two conditions, do not look upon them as being in any way necessarily combined, and we not infrequently meet with cases of movable kidney in which there is no noticeable enteroptosis.

Important changes may occur in the kidney as a result of the undue mobility, although in many cases a movable kidney is quite healthy. Perhaps the most frequent condition is intermittent hydronephrosis. In consequence of the undue mobility, the ureter becomes bent or kinked, so that obstruction to the escape of urine and consequent distension of the pelvis and calyces of the kidney may occur from time to time ; this distension is intermittent, considerable intervals often

elapsing between the attacks. In other cases the renal pedicle may become twisted sufficiently to interfere with the arterial supply and the venous return ; these circulatory troubles damage the kidney, and hæmaturia may occur when the venous return is interfered with.

Symptoms are often absent in movable kidney, and the condition may only be discovered by the surgeon while examining the patient for something else. When, however, this condition is once realised by the patient, it is remarkable how frequently symptoms arise ; such cases are often associated with neurasthenia. So long as the patient does not know that the kidney is movable—and the surgeon should never inform her, if he discovers it accidentally—there may be no trouble ; when once the patient knows, she is apt to become very morbid and neurasthenic.

In many cases, however, a movable kidney gives rise to very distinct symptoms. Those associated with mobility of the kidney alone are pain of an aching character and a feeling of weight and dragging in the loin ; this may be accompanied by attacks of sharp pain referred definitely to the renal region. Nausea or vomiting, constipation, flatulence, and a general dyspeptic condition are also common. The patient is often thin, sallow, and ill-nourished. In some cases the so-called Dietl's crises are met with, and these are supposed to be due to the kidney falling over and compressing the duodenum ; they consist of violent attacks of colic associated with nausea and vomiting and often accompanied by abdominal distension and tenderness, and sometimes by a rise of temperature and signs of collapse. Occasional attacks of jaundice may also occur, probably from pressure of the kidney on the bile-duct. When the kidney is very movable it is not uncommon to find tenderness and pain at McBurney's point, and it is by no means easy to say, in some cases, whether chronic appendicitis is present or not ; in a good many cases this pain still persists after the appendix has been removed.

In addition to these general symptoms, there are others especially associated with the kidney itself, such as intermittent hydronephrosis, renal colic, the appearance of a tumour in the loin, hæmaturia or polyuria ; the symptoms may sometimes suggest renal calculus. Most patients with movable kidneys are highly neurasthenic.

It is probable that a good many of the cases of so-called Dietl's crises are really cases of incipient hydronephrosis. The early stage of hydronephrosis may be made out by injecting a solution of collargol into the renal pelvis and then taking a radiogram (see p. 513).

TREATMENT.—In considering the question of treatment, it is important to take into account the association of the kidney trouble with enteroptosis or neurasthenia, the presence of complications—such as intermittent hydronephrosis or hæmaturia—and the condition of the kidney itself.

Palliative.—When the symptoms are not severe or when the condition is part of a general enteroptosis, it is always well to see what

can be done by non-operative means in the first instance. These have for their object: to improve the patient's general condition and increase the fat; to strengthen the muscles so that they support the abdominal organs—if necessary, to assist them by a suitable abdominal support; to treat anæmia or neurasthenia if present, and to regulate the bowels.

In the first place, a modified Weir Mitchell course may be of benefit. The patient is confined to bed for three to six weeks, and has daily massage—with special attention to the lumbar and abdominal muscles—much as in an ordinary case of neurasthenia. A certain amount of overfeeding should be practised, and large quantities of milk may be ordered with advantage. Cod-liver oil is useful, and should be combined with iron if the patient is anæmic. The bowels should be regulated.

When the patient gets up, an abdominal support (see Vol. IV. p. 512) should be worn; it should be shaped so as to lift and support the lower part of the abdomen and to give uniform support all over. A pad placed beneath the affected kidney, without any general support (as is sometimes ordered), is useless, because it is difficult to employ sufficient pressure below the kidney to keep it up, but in some cases a special pad in the right iliac region, under an abdominal belt, may be of value. Tight lacing must be interdicted, as well as violent strains, or any exertion that will produce sudden deep descent of the diaphragm. Change of scene and avoidance of worry should be secured if possible. If treatment of this kind, carried out for a considerable time, improves the condition, operative interference is unnecessary, more especially as the improvement indicates that the symptoms are due rather to enteroptosis than to the movable kidney. The patient will sometimes give a hint as to whether support will be successful by volunteering the statement that tightening the corsets relieves the dragging pain.

Operative.—Operative interference will be called for: (a) when the measures above suggested fail to relieve the patient, and the symptoms are definitely associated with the kidney alone and not combined with those of marked enteroptosis; (b) when the patient suffers from repeated attacks of renal colic; (c) when there are signs of intermittent hydronephrosis or interference with the circulation through the hilum. These two conditions may occur separately or together, and the latter is generally indicated by hæmaturia.

As to the efficacy and desirability of operation in cases of movable kidney associated with renal colic or intermittent hydronephrosis, there are no two opinions, but with regard to the value of the operation in the other conditions to which we have referred very diverse views are held; the general trend is against operation, but a few surgeons strongly advocate it.

When the kidney is healthy, when the symptoms are definitely confined to the kidney, and when the patient is not markedly neurotic, nephropexy is a satisfactory operation in the majority of cases;

unfortunately, such cases are comparatively uncommon. When the nephroptosis is part of a general visceroptosis, the operation seldom affords any real relief; indeed the patient is frequently worse after it. When the mobility of the kidney is associated with marked neurasthenia, the operation frequently fails to afford any relief, and fresh symptoms are apt to arise in connection with the operation wound; if the surgeon is tempted to perform nephropexy in these cases, it should be distinctly understood that it is only a preliminary to a prolonged course of treatment for the neurasthenic condition. It is thus evident that the cases in which nephropexy is performed must be very carefully selected.

The recurrence of the symptoms after these operations was at one time attributed to the kidney becoming loose again, and this no doubt frequently happened in the early cases; but by the more recent methods the kidney can be satisfactorily anchored in the loin. It is, however, difficult to fix the upper part of the kidney in its proper position—at any rate, by the posterior operation—and some of the recurrent symptoms may be due to the liver coming down on its upper end rather than in front of it. Indeed, it will be found in most cases that however skilfully the operation has been done the kidney is fixed at a lower level than normal, and the lower end is frequently palpable below the margin of the ribs and may become pressed on by the corsets and bands which support the clothing. In these respects, operation by the anterior route in the manner described on p. 524, presents a distinct advantage. Another cause of recurrence of the symptoms is that a small hydronephrosis may have been overlooked and not remedied. The most common reason for the recurrence of the symptoms is, however, that they are due to other causes than mere mobility of the kidney—such as enteroptosis—which have not been influenced by the operation.

Nephropexy may be performed from the back or from the front. Until quite recently, the posterior operation was the only one employed. The disadvantages of this operation are the difficulty of fixing the kidney high enough and the fact that the condition of the intra-abdominal organs—such as the appendix or gall-bladder—cannot be readily made out and remedied if at fault, without a fresh incision. By the anterior operation performed in the manner described below, these disadvantages are lessened, the position of the kidney can be more accurately regulated, and the condition of the other organs—especially the appendix, gall-bladder, stomach, and duodenum—can be ascertained and, if necessary, dealt with.

Posterior nephropexy.—The patient is turned over on the sound side, a bolster, an inflatable pillow, or a sand-bag being placed under the loin, so as to open out the interval between the crest of the ilium and the ribs upon the affected side. The kidney is best reached by an almost vertical incision, commencing above over the centre of the twelfth rib and running downwards and slightly forwards to a

point just above the iliac crest. The latissimus dorsi is divided, or its muscular fibres separated, throughout the whole length of the wound, and then the incision is carried through the transversalis aponeurosis parallel to the margin of the erector spinæ, and the peri-renal space is at once exposed. The deeper parts of the incision need not be opened up to the same extent as the skin-wound, as it is possible to bring out the kidney through a comparatively small opening in the abdominal wall if the retraction is efficient.

After the transversalis aponeurosis has been divided, the fatty capsule of the kidney, enclosed in the peri-nephric fascia, usually bulges through the opening. The peri-nephric fascia is then picked up in two pairs of forceps and opened, when the canary-coloured fat around the kidney at once becomes evident. As much of the peri-nephric fat is stripped off the true kidney capsule as possible, so that eventually no fat intervenes between the surface of the kidney and the lumbar wall, when the two are brought in contact by sutures. In a healthy kidney, the detachment of the peri-nephric fat is quite easy. The organ should always be pulled well out of the wound not merely to see that its posterior surface is thoroughly cleared and to determine the most suitable spot for the insertion of the stitches, but also to enable the surgeon to examine the kidney and the ureter in order to make sure that no other trouble is present and that there is no kink, stricture, or faulty attachment of the ureter to the pelvis of the kidney. In protruding a movable kidney, care must be taken not to twist the renal pedicle upon itself and not to mistake the upper end for the lower when returning the organ into position in the loin.

Up to this point, all the operations for posterior nephropexy practically agree, the points of dissimilarity in the operation concerning mainly the measures taken subsequently to fix the kidney in place.

The controversy as to whether the true capsule of the kidney should be partially stripped off and the bared renal substance brought into contact with the lumbar wall (decapsulation), or whether sufficient adhesion can be obtained without the kidney being decapsulated, does not appear to be finally settled as yet, although in the majority of operations practised at the present time, some form of decapsulation is the rule. Firm adhesion may, however, occur between the bared fibrous capsule and the lumbar wall, and we have had satisfactory results with both methods. Another point in which the technique varies is in the method of attaching the kidney to the abdominal wall. In all cases, sutures are employed, and in the majority these are carried through the substance of the muscles and tied subcutaneously, rather than through the transversalis aponeurosis alone. This plan makes it easier to pull up the kidney sufficiently high; if the organ is merely sutured to the transversalis aponeurosis it is difficult to work under the ribs and therefore it will probably be fastened unduly low down.

Various materials are employed for fastening the kidney, some

surgeons using silk, whilst others employ catgut or kangaroo-tendon, especially for the cases in which decapsulation has been practised.

The methods of fastening the kidney are numerous, and we shall only indicate the chief points in the two methods of suturing with or without decapsulation.

If *suturing without decapsulation* is employed, the stitches should

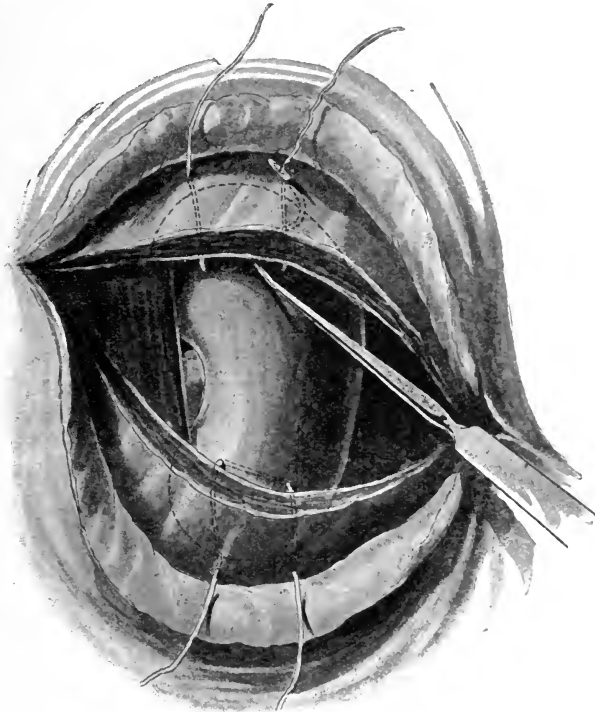


FIG. 138.—NEPHROPEXY WITHOUT DECAPSULATION. The illustration shows the method of passing the sutures through the wall of the loin after they have been inserted through the renal capsule and the kidney has been returned into place. Two sutures are used here, the ends of the upper one being made to emerge from the wall of the loin as close as possible beneath the twelfth rib. The figure shows how to pass the sutures so as to allow the cut edges of the muscles to be approximated without undue tension on the renal stitches.

be passed through the posterior surface of the kidney and not merely through the convex border; a considerable breadth of the posterior surface should be taken up, the suture emerging near the convex border. One or two stitches may be used for the upper pole of the organ; the capsule is perforated near the inner border, but not too close to the hilum, and the thread is made to underrun the fibrous capsule, emerging again just internal to the convex border. Sutures are also passed in a similar manner at the lower end of the kidney. When all the stitches are in place, the kidney is returned into its bed and the sutures are then passed

through the lumbar wall. One end of the upper silk stitch is threaded into the needle and passed through the transversalis aponeurosis from before backwards as high up as possible, being made to emerge in the subcutaneous tissue just below the last rib; the other end of the silk is then passed in a similar manner at a suitable distance from the first. In many cases it is better to carry this suture through the lowest intercostal space, so as to fix the kidney high enough; this may involve puncture of the pleura, but this does not seem to be of any consequence. When these two ends are tied together, they will pull up and fix the upper end of the kidney. The lower sutures are then carried through the abdominal muscles at a lower level, and when tied will fix the lower end (see Fig. 138). These sutures should not be tied until the kidney has been placed in its proper position and the lumbar muscles united.

The assistant keeps the kidney firmly pressed in place, and all the peri-nephric fat pushed away from between the opposing surfaces of the kidney and the transversalis fascia, while a series of mattress sutures are passed through the lumbar muscles on each side of the wound. Before these are tied, the pillow is removed from beneath the loin, and the assistant pulls the kidney well up against the lumbar wall by traction on the renal sutures. By repairing the abdominal wall before the kidney is attached to it, a more satisfactory surface is obtained for adhesion. After the stitches uniting the edges of the lumbar muscles have been tied, those holding the kidney are fastened subcutaneously

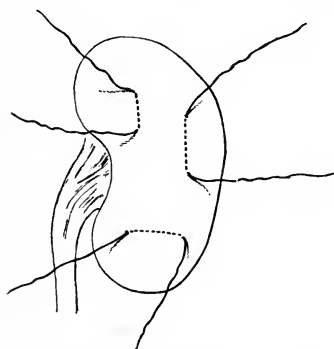


FIG. 139.—METHOD OF INSERTING THREE SUTURES IN THE KIDNEY IN NEPHROPEXY. None of the sutures must encroach upon the renal pelvis.

just tight enough to secure the organ in position. The sutures are cut short, and the edges of the skin are united; no drainage tube need be inserted.

If the kidney is to be fixed after decapsulation, the following method answers very well:—

After the kidney has been brought up on to the loin, a crucial incision is made just through the capsule on its posterior surface (see Fig. 140, A). This must not pass deeply into the renal cortex otherwise troublesome oozing may occur. The crucial incision divides the capsule on the posterior aspect of the kidney into four triangles, and the apex of each is seized in turn with a pair of forceps, the handle of the knife insinuated beneath it, and the triangular portion of capsule raised from the cortex as far as the borders of the organ (see Fig. 140, B). Sutures of medium-sized catgut are then inserted through these flaps in the manner indicated in Fig. 140, C. By this means a firm hold is obtained, and there is no

risk of the stitches pulling out or the capsule tearing through. The kidney is now returned into the loin and pushed into place by an assistant, when it will be seen at what spot the catgut stitches must be carried through the lumbar wall in order to anchor the kidney in its proper situation. It is most important to put the kidney back in place before passing the sutures through the lumbar wall, otherwise there is a risk of fixing it too low down. The sutures on the outer pair of flaps, corresponding to the convex border of the kidney, are passed first. When they are in position, their ends should be clamped in forceps, but not tied; it is then easy to see where the inner pair of sutures should go. As in the operation above described, the lumbar wall is repaired before

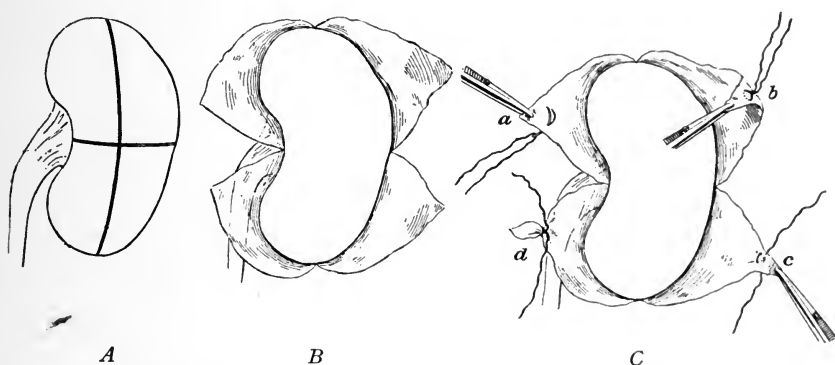


FIG. 140.—NEPHROPEXY WITH DECAPSULATION. The various stages are shown; first the crucial incision through the capsule on the posterior surface of the kidney, then the four flaps raised, and finally the four stages, *a*, *b*, *c*, and *d*, of securing the apices of the triangular flaps with catgut sutures which are afterwards passed through the lumbar wall. The suture is first passed through the flap as shown in *a*, and tied as in *b*, then it is brought round again as in *c*, and finally tied as in *d*. The suture thus cannot slip or pull out.

the stitches in the kidney are tied, and, while this is being done, the assistant keeps the organ in its place in the loin by pressure through the anterior abdominal wall in the usual way. We have never found any necessity to use more than the four sutures here described, although some surgeons employ a large number. A drainage tube is not necessary.

In this method, the whole posterior surface of the kidney is denuded of its capsule, and presents a broad area for adhesion to the lumbar parietes. The bleeding is never troublesome, and soon stops when the organ is fixed in position. The chief point of importance is to fix the kidney high enough up on the lumbar wall; its lower pole should not be lower than the middle of the lumbar region. In order to do this it will generally be necessary to pass the upper pair of sutures through the last intercostal space.

Anterior nephropexy.—Owing to the difficulty of fixing the kidney

accurately from behind, and especially of fixing its upper end, the following operation has been devised and has proved very satisfactory :—¹

The patient lies on the back with a small pillow under the loin on the affected side, projecting it slightly forward. An incision is then made parallel to the costal margin and about an inch below it (see Fig. 141). This incision commences at the outer edge of the rectus muscle, and is carried outwards parallel to the costal margin to the edge of the latissimus dorsi, or to a point where—looking down on the patient—the anterior surface of the abdomen ends. The skin, fascia, and external oblique muscle

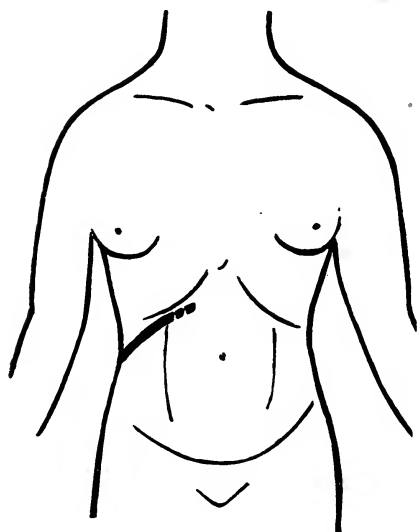


FIG. 141.—THE INCISION FOR ANTERIOR NEPHROPEXY. The continuous line is that required for operating on the kidney alone; the dotted part the extension required for exploration of the abdomen.

are divided; the fibres of the internal oblique and transversalis muscles are partly separated and partly cut across where necessary, and any nerves crossing the area can, as a rule, be pulled out of the way. The transversalis fascia is then seen, but should not be divided; it is separated from the posterior wall of the abdomen and pushed forward along with the kidney and the peritoneum. The edges of the wound being well retracted, and the fascia and peritoneum being held well forward, the kidney can then be readily felt in the anterior wall of the wound, and is fixed by the assistant's hand placed on the front of the abdomen. An incision is then made in the peri-renal fascia over the posterior part of the kidney,

and the renal fat at once protrudes. This incision is enlarged, and the peri-renal fat and fascia are stripped outwards and the fat in part removed. The posterior surface of the kidney is now exposed (see Fig. 142) and the organ shelled out of the fascial capsule and brought out of the wound. The posterior wall of the abdomen is cleared of its fat until the diaphragm, the psoas, and the quadratus lumborum muscles are fully exposed. The kidney is then turned forwards, and incisions are made through the capsule on the posterior surface in the manner shown in Fig. 143—namely, a vertical incision running upwards near the inner side of the posterior surface to the upper edge of the kidney, curving forwards at its upper end, and a transverse incision curved somewhat downwards

¹ See 'Movable Kidney, with details of an Operation for fixing the Kidney,' by Sir W. Watson Cheyne, *Lancet*, 1909, vol. i. p. 1155.

at the outer end, and running across the kidney rather below its centre. The capsule is now stripped off as far as the outer border and lower end of the kidney, so as to form two flaps, the greater part of the posterior surface of the organ being thus decapsulated (see Fig. 143). The fatty capsule and these flaps are held out of the way while the kidney is turned back and placed exactly in the desired position on the posterior wall

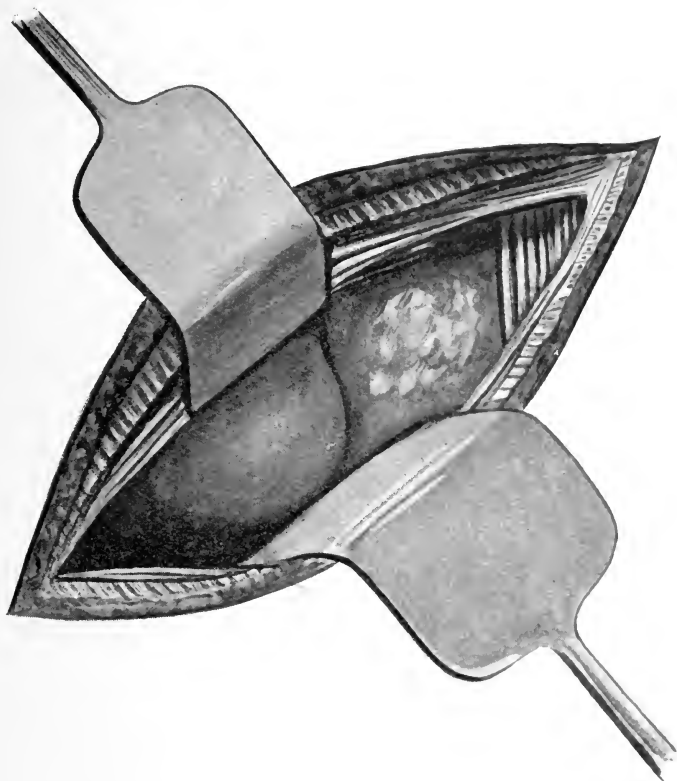


FIG. 142.—ANTERIOR RETRO-PERITONEAL NEPHROPEXY. The rectus is shown exposed by the division of its sheath so as to allow the peritoneum to be opened and the abdominal viscera examined.

of the abdomen. The capsular flaps are then stitched to the muscles around the outer and lower border of the kidney, so as to keep the raw posterior surface of the organ in close contact with the muscles; the peri-renal fascia is also stitched down at the lower part so as to form a shelf, which gives additional support to the lower end of the kidney (see Fig. 144). The peritoneum is allowed to fall back in position, and a few stitches will bring the deeper muscles together, while the edges of the external oblique are brought together by mattress sutures and subsequently by a continuous stitch.

Apart from the accuracy with which the kidney can be fixed in position by this anterior operation, it possesses another advantage. Everyone is familiar with the difficulty in these cases of being quite certain that all the symptoms are due to the mobility of the kidney, and in some cases there may be considerable doubt whether they may not be due, among other conditions, to gall-stones, duodenal ulcer, hepatoptosis and enteroptosis, or to appendix trouble. With the lumbar incision these

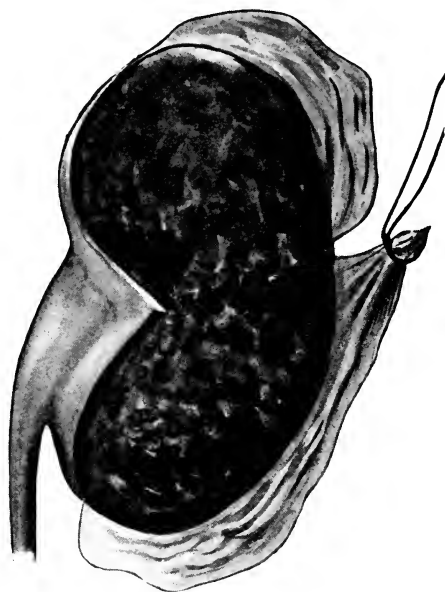


FIG. 143.—METHOD OF DECAPSULATION IN ANTERIOR NEPHROPEXY. The suture shown is for attachment to the last rib, and is fastened to the lower of the two flaps into which the capsule of the kidney is transformed. The lines of incision for forming these flaps are described in the text.

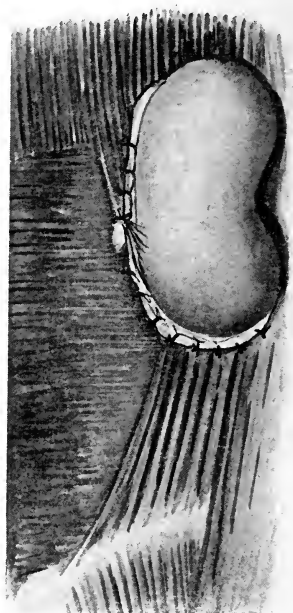


FIG. 144.—THE RELATIONSHIP OF THE KIDNEY TO THE POSTERIOR ABDOMINAL WALL AFTER ANTERIOR NEPHROPEXY. The method of suture is also shown. The stitch shown in the previous figure is tied round the last rib, and the loose flaps of the capsule are stitched down to the fascia and muscles.

organs cannot be so readily investigated as with the anterior incision. After the kidney has been exposed, the peritoneum may be divided in front of it, and the condition of these various parts ascertained, and some of the conditions referred to above can be remedied without making a fresh opening. By extending the incision somewhat forwards, gall-stones can be dealt with or the liver can be fixed, and in some cases where the appendix is not bound down to the pelvis it can be brought up and removed. Even if this cannot be done, the state of matters can be ascertained, and suitable incisions made either at once or on a subsequent occasion.

After-treatment of nephropexy cases.—The patient is kept in bed for

six weeks, so as to allow of firm adhesion of the kidney. An abdominal support (see Vol. IV. p. 512) is then applied, and the semi-recumbent position is adopted for another six weeks, the patient being allowed to turn over on to the affected side. During the period of semi-recumbency, over-feeding should be practised, as well as massage and faradism, in order to strengthen the abdominal muscles, and the bowels must be regulated. The abdominal support should be worn for at least six months. In the course of three or four months, gentle exercise may be allowed. Six months, however, should be allowed to elapse before the patient is allowed to consider herself perfectly well and able to do things like other people.

CHAPTER LII.

INJURIES OF THE KIDNEY AND URETER.

INJURIES OF THE KIDNEY.

THE kidney may be injured with or without an external wound. The latter group of cases is the more difficult to deal with ; the presence of an open wound simplifies the diagnosis very much.

INJURIES WITHOUT AN EXTERNAL WOUND.

Injuries to the kidney are most often due to crushes or blows on the abdomen or the loin ; they may follow violent lateral flexion of the trunk, and may be caused by or associated with fracture of the eleventh or twelfth ribs. They often form part of other lesions, such as fractures of the spine or the ribs, or rupture of the diaphragm, liver, spleen, or duodenum. A very important point affecting treatment is whether the peritoneum over the kidney has been torn or not, because if it has, blood and urine will escape into the peritoneal cavity and seriously complicate the case.

The injury to the kidney may be limited to hæmorrhage beneath the capsule, or there may be extensive laceration of the renal substance, tearing of the renal pelvis, injury to the renal vessels, or complete pulping-up of the organ. From the point of view of treatment, the following grouping of the cases may be useful:—

1. Injury to the peri-renal capsule alone without damage to the true capsule of the kidney or the renal tissue.
2. Bruises of the kidney, without rupture of the capsule.
3. Rupture of the kidney and its proper capsule, not extending into the pelvis of the organ.
4. Extensive rupture of the kidney substance running into the pelvis. These are the ordinary severe cases met with in practice.
5. Extreme damage, the organ being broken up into fragments or entirely pulped-up.

6. Laceration of the pelvis or the ureter alone.

The *symptoms* vary according to the nature and degree of the injury ; unless this be limited to the peri-nephric tissues, various symptoms common to abdominal injuries in general will be present, and also others special to the injury of the kidney. The symptoms common to abdominal injuries are mainly those of collapse, varying according to the extent of the injury, but generally profound ; its severity is often added to by the free hæmorrhage. Vomiting often occurs, and in bad cases may be almost uncontrollable ; there is pain localised in the renal region or diffused over the abdomen.

The special symptoms are due to the escape of blood along the ureter, or of blood and urine into the tissues around the kidney or into the peritoneal cavity ; the bleeding may be profuse, and there may be all the signs of internal hæmorrhage. The amount and situation of the bleeding are important indications of the nature and degree of the injury.

When the kidney itself has escaped serious bruising there will be tenderness in the loin, without either swelling or hæmaturia. In all other cases hæmaturia is present, and in addition there will be a swelling in the loin if there is extensive peri-nephric bleeding, or increasing dullness in the peritoneal cavity if the peritoneum is also torn.

Hæmaturia without a lumbar swelling or signs of fluid in the peritoneum indicates *that the capsule of the kidney has not been ruptured, and that the injury is limited to the substance of the organ itself* ; this is a comparatively slight form of injury, in which the amount and duration of the hæmaturia vary considerably. In the less severe cases the urine—which at first appears to consist of almost pure blood—becomes clear in the course of two or three days ; the condition of the patient at the same time steadily improves, and he may be well in a week or ten days. There may, however, be profuse and persistent hæmaturia, and this is generally indicative of rupture of some considerable vessel ; indeed, the bleeding may be so free that immediate operation is called for. In these cases the blood may coagulate in the bladder and retention of urine may occur, or it may clot in the ureter, when the patient will have attacks of renal colic and pass blood-casts of the ureter ; during these attacks the urine may be quite clear for a few hours at a time. Frequency of micturition is generally associated with the hæmaturia. In the course of ten days or so, the urine may be free from visible blood although it generally remains albuminous for a time. Nephritis may, however, occur, and there may be suppuration in the substance of the kidney or in its pelvis, the organisms gaining access from the blood-stream, the large bowel, or the bladder. In other cases, suppression of urine may occur—due either to injury of both kidneys or to injury of one alone ; in the latter case, the suppression is reflex and is most likely to occur if the other kidney is diseased.

When the capsule of the kidney is ruptured, the shock is usually very

severe, and the blood, besides escaping by the ureter, finds its way into the tissues around the kidney, and, along with the urine which is simultaneously extravasated, forms a swelling in the loin, spreading upwards under the ribs and downwards towards the iliac fossa. When there is extensive damage to the kidney the patient's condition is very serious.

When the peritoneum over the ruptured kidney is torn and there is extravasation of blood and urine into the peritoneal cavity, the shock is profound, and in addition to the hæmaturia, there is rapidly increasing pain and tenderness over the abdomen, spreading dullness, and, possibly, a swelling on the affected side. The pulse is quick, thready, and easily compressible; the vomiting is intractable, and tympanites rapidly sets in.

The chief *dangers* in connection with an injury to the kidney are continuous and excessive bleeding, inflammation and suppuration in the kidney itself or in the peri-nephric tissues, which may go on to septicæmia or pyæmia, thrombosis of the renal vein followed by emboli elsewhere, and peritonitis; when the renal artery or one of its large branches is torn, gangrene of the kidney may ensue. Later results may be hydronephrosis, pyonephrosis, or traumatic aneurism of the renal artery. Death is usually due to collapse, hæmorrhage, peritonitis, pyæmia, cystitis, hectic fever, or suppression of urine.

TREATMENT.—This may be operative or non-operative. The chief difficulty in regard to treatment is to gauge the extent of the injury to the kidney. If the injury is slight, the patient may recover without operation, but if it is severe, his life will depend on early operation. In the majority of cases non-operative treatment may be employed—for a few hours, at any rate—unless there be signs of serious hæmorrhage; in a good many cases it will not be necessary to operate.

Non-operative treatment.—The first indication is to *combat the shock* (see Vol. I. p. 117). It is well to avoid alcohol, as it may increase the hæmorrhage and irritate the kidney.

The second indication is to provide for *complete rest of the injured part*. The patient should be placed upon his back in bed, with the knees tied together and flexed over a bolster, which is prevented from slipping by a bandage passing from each end of it to the head of the bed. Should the dorsal position be intolerable, the patient may lie on the sound side. If the floating ribs have been fractured, the affected side should be fixed either by strapping or a firm binder. The strips of strapping should be about two and a half inches wide, and long enough to extend from just beyond the spinal column behind to beyond the middle line in front. They should be put on from below upwards, beginning just below the crest of the ilium and extending up well over the lower ribs, each piece overlapping its predecessor by at least two-thirds of its width. If the pain is severe, small doses of morphine may be given; this allays irritation

and quiets the patient. The arm on the affected side should be fastened to the chest.

A third indication is *to adopt measures to arrest the hæmorrhage*. It is well to clear out the colon by an enema. Nothing but ice should be given by the mouth lest vomiting should be set up, which might seriously increase the bleeding from the kidney. If there is much blood in the urine, it is well to apply cold by Leiter's tubes over the kidney region, front and back. Subcutaneous injections of ergotinine citrate (gr. $\frac{1}{100}$) should be employed in preference to hæmostatics by the mouth; these should not be given until twenty-four hours have elapsed on account of the risk of vomiting being set up. Among the hæmostatics that may be employed internally are gallic acid (gr. x), pil plumbi c. opio (gr. ij-iv), turpentine (℥x) every three or four hours, and dilute sulphuric acid (℥x-xv), which may be given with lemon syrup and is comforting when the patient suffers from extreme thirst, as he commonly does.

It is well to empty the bladder both for diagnostic purposes and also because there is often retention from shock, and a distended bladder causes backward pressure, and may lead to increased extravasation of urine or congestion of the kidney. In doing this every possible precaution must be taken to disinfect the orifice of the urethra and the instruments, because infection is especially apt to occur in these cases (see p. 374).

In a very short time—sometimes, indeed, from the first—the question of operation must be considered and decided; the indications for operation are given in full below. If no operation is deemed necessary, the application of cold should be continued, and also, if necessary, the injections of ergotinine; when the stomach has quieted down, dilute mineral acids may be given by the mouth. The diet must be fluid, unirritating, and restricted in amount. About four ounces of milk should be given every two hours. It is desirable to limit the amount of fluid absorbed, so as to minimise the work that the kidney has to do. When obstinate vomiting is present, rectal feeding (see Vol. IV. p. 257) must be employed. The bowels should be cleared out in the first instance, but may then be left alone for a day or two; after the second day, mild saline purgatives should be given.

If the hæmaturia is profuse, the blood may clot either in the ureter or the bladder, and may cause much trouble. Clots in the ureter give rise to attacks of renal colic, and a persistence of this trouble is one of the indications for operative interference. In most cases there is a certain amount of clot in the bladder, but this does not usually give rise to trouble.

Operative treatment.—Operation will be called for:—

1. When hæmorrhage is profuse, and it is evident that delay may lead to immediate death of the patient from loss of blood.

2. When serious hæmaturia persists.

3. When clots in the ureter seriously interfere with the flow of the urine

4. When there is hæmorrhage and extravasation of urine in the loin.
5. When there is laceration of the peritoneum and extravasation of blood and urine into the abdominal cavity.
6. When peri-renal suppuration occurs.

In recent cases.—It is important not to persevere too long with expectant treatment or to be deceived by the small amount of blood escaping from the bladder, and thus overlook an accumulation of blood and urine in the loin or in the peritoneal cavity. Exposure of the kidney, in order to ascertain the nature of the trouble and remedy it, is not a very serious operation; if intervention is delayed until the patient is almost moribund from loss of blood, from peritonitis, or from peri-renal cellulitis, a good result cannot be looked for. Hence, whenever the surgeon has reason to believe that extravasation of urine is occurring or that active hæmorrhage is going on in spite of treatment, the kidney should be exposed without delay.

Except in the cases in which there is reason to believe that extravasation is taking place into the general peritoneal cavity, the exploration of the kidney should be made through the loin by an oblique incision (see p. 565); as it is necessary in these cases to explore and clear out the whole region around the kidney, the deeper muscles should be separated to the same extent as the skin-wound, so as to expose the whole field of operation. When this region has been exposed, the further steps will depend upon what is found. In most cases the capsule will be torn and blood and urine will be extravasated into the loin, and therefore blood-clot and, possibly, urine will be found around the kidney as soon as the peri-renal fat has been opened up. This must be cleared out and, if free bleeding is going on, the pedicle of the kidney should be grasped between the fingers of the left hand, and its vessels compressed; this compression should be entrusted to an assistant, so that the surgeon has both hands free, and then the clearing out of clots and the examination of the kidney can be proceeded with. Any vessel bleeding outside the kidney is clamped, and the organ is isolated and brought out into the wound if it is not too much torn; this must be done very carefully otherwise the laceration of the kidney may be increased.

The subsequent treatment will depend upon the nature of the lesion found, and the main question will be whether the kidney can be saved or whether nephrectomy is necessary.

Nephrectomy is indicated when the kidney has been so damaged that the patient, apart from the risk of hæmorrhage and suppuration, will be left with a kidney that is useless to him if he recovers; this is very likely to be the case when the damage is great and extends into the pelvis or the upper part of the ureter. Nephrectomy may also be necessary when the bleeding comes from one of the main arteries, ligature of which would probably mean sloughing of a portion of the kidney, and it will also be called for in the great majority of cases in which

the peritoneum has been torn, and blood and urine are effused into the peritoneal cavity. It is obviously the only course when the kidney substance is completely pulped up.

Conservative treatment.—In many cases nephrectomy is not necessary. Even in the severe cases, in which the organ is torn across more or less completely by a clean-cut laceration, or even when there is more than one laceration, or portions of the kidney are partially detached, it may still be possible to save it.

The arrest of hæmorrhage is the first consideration, and it may be effected by tying bleeding points, by plugging the wound in the kidney, or by approximating the cut surfaces firmly with sutures. The chance of tying the bleeding vessels is small, as ligatures cut through the renal cortex and are useless unless only the smaller branches of the renal

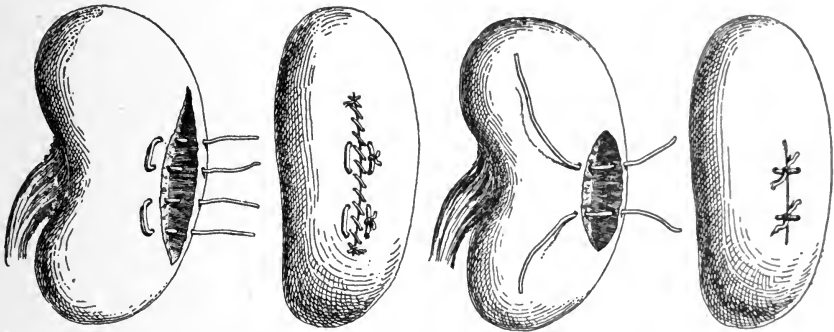


FIG. 145.—METHODS OF SUTURING A LACERATION OF THE KIDNEY. Two methods are shown. The two left-hand sketches show how an extensive laceration may be repaired by means of deep mattress sutures, reinforced by a continuous suture through the capsule. The two right-hand figures show how a smaller wound may be closed by deep sutures only. As a rule the lacerations of the kidney are transverse to the long axis of the organ rather than vertical as depicted above.

artery are torn close to the hilum or in the capsule. Ligature of the main branches of the renal artery would entail sloughing of a corresponding portion of the kidney; hence in the great majority of cases the best method of arresting hæmorrhage is either by plugging or by deep sutures, and of these the latter plan is much superior and should be adopted when possible. Mattress sutures of chromicised catgut or kangaroo-tendon passed deeply through the kidney substance (see Fig. 145), and tied outside the capsule, will press the torn surfaces as firmly together as possible, and will generally arrest the hæmorrhage; this method is also applicable when there is more than one rent, provided that the kidney substance is not actually pulped-up. The sutures must not perforate the calyces or the pelvis of the kidney, and may be reinforced by a continuous catgut suture which unites the rent in the capsule. A great advantage of this plan is that it not only stops the hæmorrhage but also prevents the escape of urine into the peri-renal tissues.

After the rent has been stitched up, two or three sutures should be passed between the capsule of the kidney and the lumbar muscles so as to anchor the kidney in place, and drainage tubes are inserted into the peri-renal space so as to carry off urine or blood; these may be removed in three or four days if there is no further accumulation and if the wound remains aseptic. The abdominal wall should be repaired by silkworm-gut sutures passing through the skin and the whole thickness of the loin muscles; buried stitches should not be employed, as suppuration may occur in the wound, and in that case the stitches will be extruded. These stitches are removed after ten to fourteen days.

When a portion of the kidney is almost detached, the question will arise whether the surgeon should merely remove this portion or should take away the whole kidney. The decision depends upon the possibility of arresting the hæmorrhage; if this is only moderate in amount after the lacerated portion has been removed, it may be arrested by stitching the kidney to the abdominal wall and applying a firm tampon of gauze.

When the kidney is much torn and it is impossible to arrest the hæmorrhage by ligatures or sutures, the only plan short of nephrectomy is to plug the lacerations with strips of gauze. The organ must first be sutured to the loin, and then the torn portion is tightly plugged with gauze. The results are not, however, very satisfactory, because it is difficult to exert sufficient pressure on the kidney to arrest the hæmorrhage. When gauze-plugging is employed, no drainage tube is necessary because the gauze itself acts as a drain, so long as the discharge is not purulent. The greater part of the wound should be left open, but silkworm-gut sutures may be carried through the whole thickness of the loin, and the loops tied and left ready to be tightened up as the gauze is removed. Should no suppuration occur, it will be several days before the deepest portion of the gauze will come away easily. The patient must lie on his back, or with a pillow beneath the injured side, while the arm on that side is fixed to the trunk by a binder, and the legs are flexed over a pillow and the knees tied together.

When the peritoneum is lacerated and there is extravasation of blood and urine into the peritoneal cavity, immediate operation is imperative. The operation should be trans-peritoneal, the incision being made just inside the linea semilunaris on the affected side (see p. 590). When the abdomen has been opened, the peritoneum outside the colon is divided, the latter drawn towards the middle line, and the kidney exposed. In the majority of cases, the best plan is to perform nephrectomy at once, unless there be reason to suspect serious disease of the other kidney. In a few cases the rent in the kidney may be small and can be closed by mattress sutures (*vide supra*); in that case a counter-opening for drainage is made in the loin, and the rent in the peritoneum is sewn up. As a rule, however, nephrectomy is advisable, not only on account of the severe lesions in the kidney, but in order to prevent further

escape of urine into the peritoneal cavity after the operation ; in all cases search must be made to see if the bowel has also sustained injury. The operation is terminated by the removal of the blood and urine from the peritoneal cavity—particularly from Douglas's pouch, to which it usually gravitates. If the operation is done early, sepsis may not have occurred, and will be avoided should subsequent escape of urine into the peritoneal cavity be prevented.

In long-standing cases.—The surgeon may not operate until some considerable time has elapsed, or he may not see the patient until several days after the injury. In these cases an exploration may be necessary on account of secondary hæmorrhage, but it is more probable that it will be called for on account of peri-nephric suppuration or the presence of a large collection of blood and urine; and the treatment will vary accordingly.

The treatment of secondary hæmorrhage is difficult, as it is not easy to identify the bleeding point, or to secure it when found. The best plan is to turn out the clots as completely as possible, and then, having found the spot from which the bleeding is coming, to try to clamp the bleeding point, or; failing that; to plug the wound firmly with strips of cyanide gauze. Enough pressure can usually be brought to bear on the bleeding point, as by this time the kidney is firmly fixed by adherent clot. If it is possible to clamp the vessel, the forceps should be left on for forty-eight hours; and no attempt should be made to tie the vessel. When packing is employed; it should be removed as it gets loose, and renewed until all bleeding has stopped, when the incision in the loin may be brought together if there is no suppuration; a drainage tube should, however, always be inserted. For the treatment of peri-nephric suppuration; see Chapter LIII. When suppuration occurs in the interior of the kidney, nephrotomy and drainage may suffice, unless foci of suppuration are scattered through the substance of the organ, when nephrectomy will give the patient a better chance. When suppurative peritonitis has resulted from a wound of the peritoneum, the treatment must be on the general principles laid down in Vol. IV.

INCISED AND PUNCTURED WOUNDS.

These are rare in civil practice, and are usually accompanied by injuries of other structures—such as the peritoneum, colon, or spleen; they may or may not be accompanied by protrusion of the organ. All the conditions that occur after subcutaneous injuries may be met with in these wounds, with the addition that, if the external opening is sufficiently large, blood and urine escape through it.

TREATMENT.—When the wound is a mere puncture, limited to the kidney and not accompanied by any serious hæmorrhage or escape of urine, nothing is necessary—in the first instance, at any rate—beyond

enlarging the wound sufficiently to secure disinfection of the soft parts. When the injury is more severe and is accompanied by brisk hæmaturia and signs of accumulation of fluid in the loin or in the peritoneum, it is desirable either to enlarge the opening sufficiently to expose the kidney, or else to make a fresh incision in the lumbar region. The treatment of the damaged organ itself will be carried out on the lines already laid down for subcutaneous lacerations.

Hernia of the kidney. — The kidney is sometimes protruded partially or entirely through the wound in the loin, and the treatment will then depend upon the condition of the viscus. If it is seriously damaged and there is little chance of its recovery, it will of course require removal. Slighter forms of injury must receive treatment on the lines already laid down (*vide supra*).

Among the rare results of injury to the kidney, the formation of an *aneurysm of one of the branches of the renal artery* may be mentioned. It is unnecessary to go into the treatment of this condition because the diagnosis is seldom made during life, most of the recorded cases having been looked upon as malignant tumours of the kidney. Should such a case be diagnosed during life, the only treatment is nephrectomy, and the feasibility of this depends largely upon whether the renal artery itself is involved or not, and whether it is possible to apply a ligature between it and the aorta.

INJURIES OF THE URETER.

Injuries of the ureter may occur independently of injury of the kidney, and are most common as the result of some abdominal operation. Subcutaneous rupture of the ureter is known, but the accident is extremely rare. The symptoms are collapse, hæmaturia, pain and tenderness, vomiting, and the formation of a swelling in the iliac region.

Should the condition be diagnosed, the treatment will be to expose and attempt to repair the torn ureter or, failing that, to implant it into the bladder or the bowel (*vide infra*), or to bring it out in the loin. When this is impossible nephrectomy will be necessary.

The most important cases are those in which the injury occurs during some abdominal operation, such as hysterectomy or ovariectomy. They may be divided into four groups:—

- (a) Complete division of the ureter.
- (b) Complete division with removal of a portion of the ureter.
- (c) Partial division of the ureter.
- (d) Inclusion of a portion of the ureter in a ligature followed by sloughing. Sloughing of the ureter may also occur after child-birth from prolonged pressure.

The injury may be recognised immediately it occurs, or it may not

be noticed until urine escapes from the wound; when the ureter has been included in a ligature, the true condition may not be recognised until the ligature has separated, and a ureteral fistula has become established. If the condition is not recognised at the time of the operation, the prognosis will depend to a considerable extent on whether the urine escapes into the peritoneal cavity or into the vagina, and also on whether the urine is aseptic or not. If aseptic, its escape into the peritoneal cavity may merely give rise to a localised collection of urine, which gradually makes its way through the line of incision and leads to a urinary fistula; if it is septic there will be acute peritonitis.

TREATMENT.—As wounds of the ureter are rare and are comparatively seldom recognised, most of the suggestions as to treatment are based upon experiments on animals rather than upon actual operations on man. A certain number of operations have, however, been done on man and they help to indicate which are the best methods.

We shall consider the treatment under the following heads:—

- (a) When the injury is recognised at the time.
- (b) When the injury is not recognised until some hours later.
- (c) When the injury is unnoticed until a ureteral fistula has become established.

The treatment will vary according as the ureter is completely or partially divided, and in the former case according as a portion has been lost or not.

The most important cases are those in which the injury is recognised at the time of the operation, and the surgeon has to repair it on the spot, and has no time to consult authorities. When a fistula has developed, he has time to plan out the most appropriate procedure, and can make a choice from a large number of methods.

The chief methods of dealing with this accident are the following:—

1. Ligature of the distal end, and suture of the proximal in the abdominal wound.
2. Anastomosis of the divided ends.
3. Implantation of the proximal end into the bladder.
4. Implantation of the proximal end into the bowel.
5. Detachment of the bladder or the creation of a diverticulum in it so as to graft the ureter into it when a portion of the latter has been lost.
6. Nephrectomy. Primary nephrectomy for wounds of the ureter may be entirely dismissed; secondary nephrectomy may be required later on should the kidney become disorganised by sepsis or hydronephrosis, or should the patient insist on having the organ removed owing to the annoyance caused by a permanent urinary fistula.

(a) Of recent wounds.—When the ureter has been completely divided, but no portion has been removed, the simplest method of treatment is some form of uretero-ureteral anastomosis; when so much

of the tube has been lost as to render this impossible, grafting the proximal end of the ureter into the bladder or the bowel, or bringing it out on the skin, must be had recourse to.

Ureteral anastomosis. — The different methods of uretero-ureteral anastomosis are founded on Fenger's experiments, and may be divided into four groups: (*a*) transverse end-to-end union; (*b*) oblique end-to-end union; (*c*) end-in-end union; and (*d*) lateral implantation.

End-to-end anastomosis, whether transverse or oblique, consists of union by Lembert's sutures. Leakage is, however, very apt to occur,

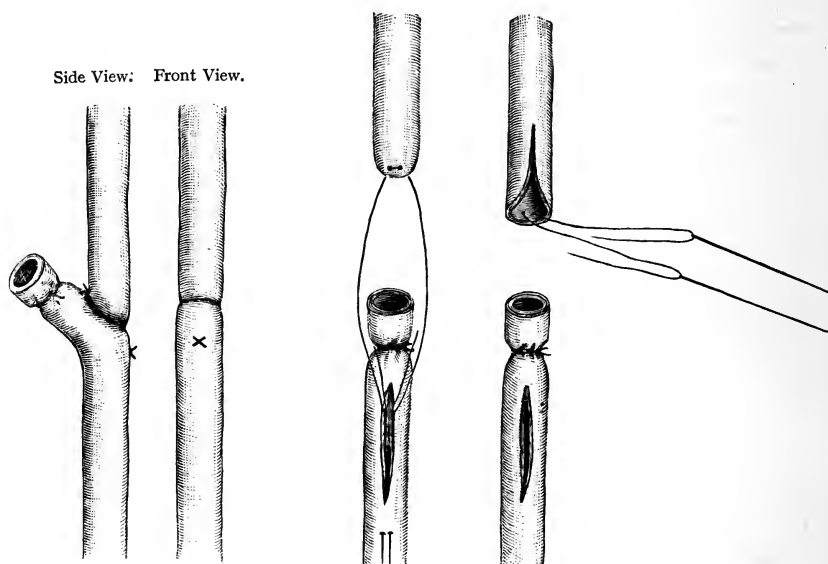


FIG. 146.—VAN HOOK'S METHOD OF URETERO-URETERAL ANASTOMOSIS BY LATERAL IMPLANTATION. The two left-hand figures show the appearance of the ureter when the anastomosis is complete. The X on the second figure is the point at which the ligature emerges from the lower end and is tied. (Morris.)

and stenosis is almost certain to follow. *End-in-end operations* are only applicable when the ureter is much dilated, the plan being to pull one end of the ureter into the other and secure it by sutures.

Lateral implantation is the method which apparently gives the best results, and the one which we shall describe, as the surgeon must be acquainted with it, and may have to carry it out in an emergency. *Van Hook's method* is in the first place to ligature the distal portion of the ureter about a quarter of an inch from the divided end. A longitudinal incision is then made below this ligature with sharp-pointed scissors, the length of the incision being double the diameter of the tube. The proximal end of the ureter is slit up for about a quarter of an inch; this enlarges its opening, and therefore allows for subsequent contraction. Two needles, threaded on a single catgut thread, are then passed from

within outwards, one-sixteenth to one-eighth of an inch apart, through the upper end of the ureter and about an eighth of an inch from the cut edge (see Fig. 146). The loop of catgut thus grasps the end of the ureter firmly. The needles are now passed through the slit in the lower end of the ureter and down the tube for half an inch, and are then pushed obliquely through its wall side by side. When the two ends are pulled upon, the upper end of the ureter is drawn into the lower, and the loop is tied. A continuous Lembert suture is then applied around the line of union of the two portions. To strengthen the union, the line of junction is enveloped by peritoneum, or a fold of omentum is sewn over it; the former plan is the better. Care must be taken to avoid soiling the wound and the peritoneal cavity. The parts should be packed off and the ends of the ureter covered until the surgeon is ready to unite them; before proceeding with the union, the ureter should always be probed to see that it is patent. As the injury nearly always occurs in the pelvis the Trendelenburg position is advisable.

A drainage tube should be inserted down to the ureter, but not actually touching it; if no leakage or sepsis occurs, it can be dispensed with in four days. A catheter should be retained in the bladder for two days in order to prevent the bladder becoming distended and causing strain upon the sutures.

Ureteral grafting.—Ureteral anastomosis is not always possible; even in recent cases, it is very difficult to carry out when the ureter is wounded low down in the pelvis: the alternatives are to graft the ureter into the bladder (see p. 540), the intestine (see p. 543), or the vagina (see p. 541), or to attach it to an opening in the skin.

The ideal operation is to graft the ureter into the bladder, and this should be done when the site of injury is close to that organ. Grafting it into the bowel is a much more serious procedure, partly on account of the risk of stenosis of the ureteral orifice, and partly because of the danger of ascending septic infection. If the ureter is to be grafted into the bowel, it is better to implant it into the colon than into the rectum, as in the former case there is more room for accumulation of the urine, and therefore there is not the same necessity for repeated evacuations, while at the same time the contents of the bowel pass on more quickly, and are not so long in contact with the ureteral orifice. Bringing the end of the ureter out on to the skin no doubt also entails a certain risk of ascending septic infection, but this may be minimised by careful attention. The escape of urine on to the skin, however, is most objectionable, and in most cases, when the other kidney is sound and it is impossible to restore the lumen of the ureter, the patient will insist on a nephrectomy. Grafting the proximal end of the ureter into the vagina is perhaps preferable to creating a cutaneous urinary fistula, since an attempt may be made to perform uretero-vesical grafting subsequently. It is only when the damage to the ureter is too high up for this that the ends should be brought

out on the skin. The steps of the method are described in connection with ureteral fistula (*vide infra*). In practice it has to be borne in mind that, if the ureter is injured in the course of a severe abdominal operation, such as hysterectomy, the patient may not be able to stand any elaborate procedure, such as uretero-ureteral anastomosis or uretero-vesical grafting, and it may be necessary to bring out the proximal end of the ureter either into the wound or into the vagina, after applying a ligature to the distal end. The patient is thus left with a fistula, until she is well enough to undergo a more elaborate plastic operation.

Nephrectomy.—Nephrectomy is a last resource, and should only be employed as a secondary procedure when the kidney has become disorganised by ascending septic infection or by hydronephrosis or when the surgeon fails to cure the fistula and the patient insists on having something done to get rid of it.

When the ureter is only partially divided, either longitudinally or obliquely, it should be closed by Lembert sutures, and a drainage tube inserted down to the incision, in case extravasation should occur. If the wound be intra-peritoneal, the line of suture should be covered by a fold of peritoneum or by an omental graft; if it is retro-peritoneal, it may suffice to introduce a tube down to the vicinity of the opening without attempting suture. In the rarer cases in which a portion is cut out of the side of the ureter, an attempt may be made to close the opening by increasing the transverse diameter of the ureter, as is done in pyloroplasty (see Vol. IV.).

(b) **Of ureteral fistula.**—These fistulæ may open on to the skin or into the vagina, and may give rise to so much annoyance that operative measures must be undertaken for their cure. There are three forms of operation to choose from—namely, implantation of the divided end of the ureter into the bladder or bowel, or nephrectomy. These operations may also be required for stricture at the lower end of the ureter, when resection of portions of the bladder involves the ureteral orifice, for certain cases of calculus impacted at or near the lower end of the ureter, or for cases of cancer of the uterus or other pelvic organs involving the ureter.

Uretero-vesical anastomosis.—This has been done successfully on several occasions. The ureter may be reached either behind or through the peritoneum, or through the vagina.

The trans-abdominal extra-peritoneal method.—This operation may be done in the following manner: The patient is placed in the Trendelenburg position, a median laparotomy performed, the peritoneum opened, and the intestines retracted. The ureter is then traced down, and its lower end freed and split up for about one centimetre. The bladder is projected in the neighbourhood of the ureteral orifice by means of a sound introduced into it and an incision made about two fingers' breadth above the normal ureteral opening; into this opening the end of the

ureter is sewn by sutures taking up the whole thickness of the walls. The incision in the pelvic peritoneum is then closed, the peritoneum detached from the pubes backwards to the region of the anastomosis, and a drain introduced so that any leakage that may occur shall be extra-peritoneal.

The operation may also be done on the principle of Witzel's operation for gastrostomy (see Fig. 147). The abdomen is opened and a small incision made in the peritoneum over the iliac vessels and the ureter isolated. By slight traction, the ureter is then defined in the broad ligament, an incision made through the peritoneum over it, and the ureter divided between two ligatures by an oblique cut. The distal end is buried, while the proximal end is pulled out through the incision over the iliac vessels; a pair of long forceps is then insinuated behind the peritoneum from the abdominal incision near the bladder up to this point, and the ureter seized and drawn down to the bladder. All the incisions in the peritoneum are then closed, so that the remainder of the operation is done extra-peritoneally. The bladder is distended with boric lotion and brought over to the affected side, so that the end of the ureter can readily lie upon its upper surface, and is then fastened by sutures to the transversalis fascia. A small opening is next made in the bladder, opposite the point where the lower end of the ureter lies; and the latter is attached to the bladder by two rows of sutures—the first uniting mucous membrane to mucous membrane, and the second joining the muscular coats only. A fold is now made in the bladder, parallel to the ureter, and the lips of this are united so as to form a complete canal, in every respect resembling Witzel's operation for gastrostomy. A catheter is left in the bladder, and a drain carried down through a separate opening in the abdominal wall.

Intra-peritoneal methods.—In this group of cases, the ureter is dissected from its bed and drawn across the peritoneal cavity and the pelvis to reach the bladder. This may be the only way available when much of the ureter has been lost.

Vaginal operations.—These fall into two groups: those in which the

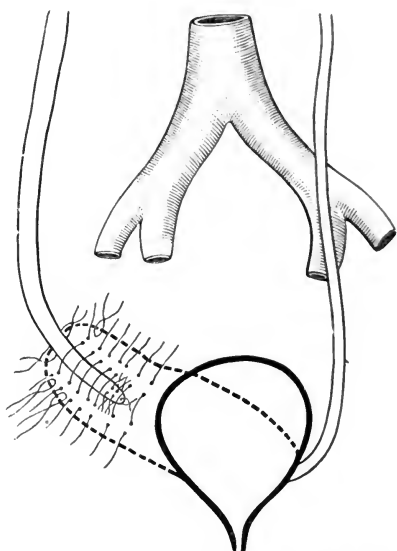


FIG. 147.—WITZEL'S OPERATION FOR URETERO-VESICAL ANASTOMOSIS. (Morris.)

entire fistulous orifice is grafted into the bladder, and those in which the fistulous orifice is removed, and a new communication is made between the end of the ureter and the bladder. Grafting of the fistulous orifice bodily into the bladder seems the better procedure, as giving a more extensive area for union, and because a new ureteral orifice has already been established; thus the chances of contraction and ascending infection are less than when a fresh orifice is made. The fistulous opening into the vagina is surrounded by an incision, which embraces the whole thickness of the vaginal wall, and the flap containing the end of the ureter is freed. This incision is now carried far enough forwards to expose the bladder wall, which is incised at a suitable spot. The edges of the

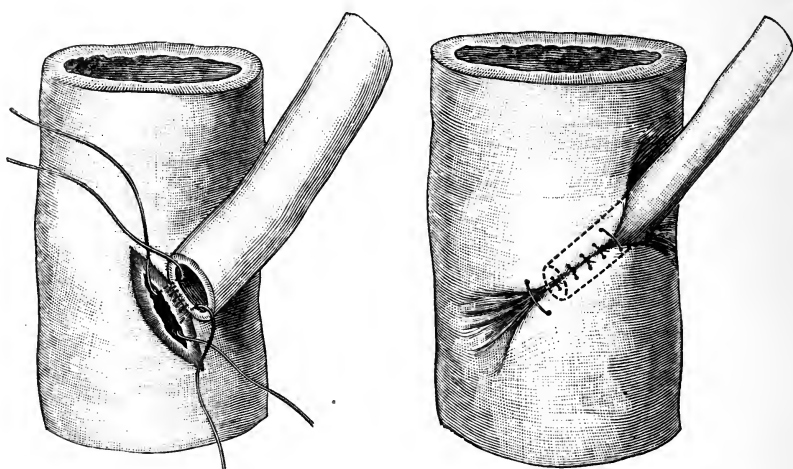


FIG. 148.—CHAPUT'S METHOD OF URETERO-INTESTINAL ANASTOMOSIS. The end of the ureter should be cut obliquely. The method is similar to Witzel's gastrostomy. (Morris.)

flap containing the end of the ureter are then sutured to the bladder wall by a double row of sutures, and the wound in the vagina is closed.

The operations described above can only be employed when the injury in the ureter is close enough to the bladder to allow the two structures to be united without undue traction. Tension not only prevents union by pulling the two structures apart, but diminishes the calibre of the ureter, and thus may produce hydronephrosis. There is also a risk of stenosis and of renal infection from ascending sepsis in every method, but these are not sufficient arguments in favour of nephrectomy as opposed to a plastic operation. The liability to stenosis is diminished by slitting up the end of the ureter before it is united to the bladder, and the risk of the infection of the kidney is not very great if the patient is in good condition and the bladder healthy. Even when pyelitis already exists, it seems better to perform this operation than to resort at once to nephrectomy. The chief trouble after these operations

is due to the absence of the valvular orifice, so that, when the patient micturates, urine is forced up through the ureteral orifice, causing backward pressure on the kidney ; probably, the more obliquely the ureter is united to the bladder, as in Witzel's method, the less is the chance of regurgitation. A catheter should always be kept in the bladder for some days after the operation, in order to prevent any distension or backward pressure.

Uretero-intestinal anastomosis.—When the fistulous opening is in such a position that the ureter cannot be made to reach the bladder, the procedure that suggests itself is to graft the ureter into the intestine ; and this has been done with success not only for a fistula of the ureter, but also in cases of malignant disease in the pelvis blocking the ureters and in extroversion of the bladder. For choice, the grafting is done into the sigmoid flexure on the left side, and into the cæcum on the right. In both cases, a method similar to Witzel's should be followed (see Fig. 148).

The bad results that may follow grafting into the bowel are stenosis, with consequent hydronephrosis (which may occur after any of these plastic operations), infection by the bacillus coli communis, and infective peritonitis. In cases such as extroversion of the bladder, in which the natural ureteral orifice exists and can be grafted bodily into the rectum, the result may be excellent (see Chap. XLI.).

CHAPTER LIII.

THE INFLAMMATORY AFFECTIONS OF THE PERI-NEPHRIC TISSUES, THE KIDNEY, AND THE URETER.

THE inflammatory affections that come under the care of the surgeon are practically all of a suppurative character, and may be divided into three classes: peri-nephric inflammation, pyelitis and pyonephrosis, and pyelonephritis.

PERI-NEPHRIC INFLAMMATION.

Non-suppurative inflammation of the tissues around the kidney may occur in connection with inflammation in the kidney itself, such as pyonephrosis or tuberculosis, and may give rise to adhesions between the capsule of the kidney and the tissues around; this affects the question of nephrectomy, but does not of itself call for any special treatment. The important cases are those of peri-renal abscess.

Abscess in the peri-renal region may be due to various causes, some of them independent of disease of the kidney; when they arise in connection with renal disease they may or may not communicate with the interior of the kidney or its pelvis. Hence we may classify peri-renal abscesses into three groups: those independent of disease of the kidney; those which occur along with inflammation of the kidney, but in which there is no communication between the abscess and the interior of the organ; and those in which the peri-renal abscess is due to a fistulous communication between the interior of the kidney and the fatty capsule.

Peri-nephric suppuration, independent of renal disease, may follow injuries such as a blow on the loin, a strain, or a punctured wound not involving the kidney. Sometimes the only history is that of a chill preceding the development of the symptoms. Abscesses in this region may also result from extension of inflammation from neighbouring parts such as the appendix, the pelvis, the colon, the duodenum, or the gall-bladder. Peri-nephric abscess may also occur in the course of some general septic condition or of a specific fever; it is not a very uncommon sequela of pneumonia.

Of the other two varieties of peri-nephric abscess, it is more common for the abscess to originate in connection with pyelitis or pyelonephrosis; with or without perforation of the kidney substance. Here there are symptoms of kidney trouble, such as hæmaturia or pyuria, in addition to the signs of peri-nephric suppuration.

The *symptoms* vary according to whether or not suppuration has occurred. Peri-nephric inflammation is accompanied by a peculiar flexion of the spine which is bent somewhat antero-posteriorly, and inclined to the affected side. The patient experiences pain in walking or stooping, and at the same time the thigh on the affected side is drawn up, and movement causes pain. The temperature is high— 103° to 104° F.—and there is generally intense, deep-seated tenderness in the loin, most marked above the crest of the ilium, and just outside the erector spinæ muscle.

When suppuration has actually set in, rigors frequently occur, the pain increases, and there is œdema of the cellular tissue in the flanks with firm contraction of the loin muscles; a fluctuating tumour presently appears, and the pus may make its way through the fascia into the subcutaneous tissue of the loin. Fluctuation is more easily elicited by examination under anæsthesia, with one hand on the front of the abdomen and the other in the loin. It is seldom, however, that the case is allowed to go on until fluctuation can be distinctly made out; the presence of pus will be inferred from the length of time the inflammation has lasted, the character of the temperature, and the information afforded by a blood-count (see Vol. I. p. 495). Unless the peri-nephric inflammation be secondary to suppuration in the kidney, examination of the urine does not help the diagnosis. Some information as to the site of the abscess may occasionally be gained by noting the character of the pain. When the abscess occurs about the upper part of the kidney, the pain is usually of a pleuritic character. When the suppuration is opposite the centre of the organ, the pain is referred along the ilio-hypogastric and ilio-inguinal nerves, and is felt in the groin and scrotum, and this may distract attention from the actual seat of the inflammation; when the abscess originates about the lower end of the kidney, the pain is mainly referred to the hip and thigh, along the external cutaneous, anterior crural, and obturator nerves, and may be present on the inner side of the knee.

If left alone, the abscess spreads in directions varying according to the situation in which it originates. An abscess in the upper part of the peri-nephric space spreads forwards, and gives rise to a subphrenic abscess or an empyema. When in the lower part, it spreads downwards to the iliac fossa, and may point in the neighbourhood of Poupart's ligament. When pus forms about the centre of the renal area, it tends to spread directly backwards and point in the loin. The pus contained in the abscess has often a fæcal odour, although there may be no communication with the bowel, and it is not uncommon to find the bacillus coli present in large numbers.

The *diagnosis* is often difficult in the early stages, and the affection may be mistaken for hip disease, lumbago, spinal disease, empyema, or pneumonia. If, however, the possibility of peri-nephric suppuration is borne in mind, a careful examination of the symptoms given above will generally enable a correct diagnosis to be arrived at. It is more difficult to say whether the abscess has arisen primarily outside the kidney or whether it is secondary to renal disease. The points in favour of a diagnosis of primary peri-nephric suppuration will be chiefly negative, such as the absence of changes in the urine or other signs of renal mischief, while the diagnosis is greatly strengthened by a history of injury or exposure, or a previous history of appendicitis.

TREATMENT.—This will vary with the period at which the case is seen. For the first few days after the commencement of symptoms the case must be treated as for the early stages of inflammation. The patient should be kept at rest on his back with the knee on the affected side flexed over a pillow. Saline aperients and, if necessary, enemata, should be given every day in order to empty the colon. Morphine may be administered if the pain is severe; tincture of aconite and vinum antimoniale may also be given. In the early stages, an ice-bag or Leiter's tubes may be used, but frequently hot fomentations give more relief than the application of cold.

Should the acute symptoms persist for five or six days, it may be assumed that suppuration has taken place, and an exploratory incision should be made without delay. Some surgeons puncture the loin in the first instance in order to ascertain if pus is present, but we cannot recommend this, as the needle may do damage or may fail to find pus that is actually present, and so may delay the necessary incision. The incision should be made about half an inch below the lower border of the twelfth rib, commencing close to the edge of the erector spinæ, and running outwards and downwards for three inches. This incision, which is similar to that for nephro-lithotomy, should always be adopted, as the surgeon can never be sure that he may not have to deal with a stone in the kidney. It need not be so free as the ordinary nephro-lithotomy incision in the first instance, as it can be enlarged subsequently if necessary. The soft parts are divided until the transversalis fascia has been opened, when the finger is introduced and the peri-nephric tissues are palpated in order to locate the chief swelling, and the finger or a pair of sinus forceps may then be pushed into it and the abscess cavity opened up. When the pus begins to flow, a drainage tube is inserted and the patient is turned over almost on to the back so as to allow the pus to escape.

After most of the pus has been evacuated, the finger is passed into the abscess cavity to detect and open up any loculi which may be present, and to ascertain if there is a communication between the abscess cavity and the interior of the kidney. The latter object is best attained by

gently washing away the pus with warm saline solution, and retracting the parts in a good light. Should a communication be found with the kidney or its pelvis, appropriate treatment must be adopted. If no communication is found, large drainage tubes are introduced in any direction in which there is a prolongation of the cavity; usually two or three large tubes (No. 24) will be required at first. No sutures should be inserted in the loin, but the tubes should be fastened to the skin with silkworm-gut stitches. The subsequent treatment is that of an ordinary abscess; the drainage tubes should not be removed too soon, otherwise fistulous openings are likely to occur from imperfect drainage. The lumbar muscles contract, and thus close the skin-wound rapidly, but this must be prevented until the abscess cavity has become obliterated.

Should there be any extensive prolongation of the abscess cavity, counter-openings may be required; in the first instance, it is well to introduce a long drainage tube from the loin incision to the counter opening—this tube being subsequently cut in half and shortened from each end. The wound is watched to see whether urine comes through; should it do so, and the case be one in which no stone has been found in the kidney, some considerable time should be allowed to elapse under proper drainage before anything further is done, in the hope that, as the cavity contracts, the opening in the pelvis of the kidney will close. The patient must be kept in bed until the wound has healed; this occurs fairly quickly as a rule.

It may occasionally happen that the incision fails to reveal pus; even if this is the case, operation will do good, as it diminishes congestion, and, should pus subsequently form, it will find its way through the opening. A large drainage tube should be inserted into the perinephric tissues, and the lumbar wound may be sutured round it.

SUPPURATIVE INFLAMMATIONS OF THE KIDNEY.

Four chief conditions may be met with:—

Suppurative pyelitis, without suppuration in the kidney substance. This condition often precedes the more extensive inflammatory affections of the organ, and seldom comes under treatment as a distinct affection. It may be primary, but much more frequently it is secondary to disease of the urinary organs lower down; inflammation spreads from the bladder along the ureter and reaches the pelvis of the kidney, to which it remains limited for a time.

Suppurative pyelonephritis is much more common in surgical practice. Here the suppuration in the pelvis of the kidney is combined with suppuration in the renal tissue. Although this condition may be primary, it is more commonly secondary, and it is the affection which was formerly referred to as 'surgical kidney.'

Suppurative nephritis, in which there is suppuration in the kidney itself, is not usually met with in practice apart from pyelonephritis; when it occurs alone, it is part of a general pyæmia. Occasionally, the surgeon may be called upon to deal with an abscess of the kidney resulting from the coalescence of isolated pyæmic foci.

Pyonephrosis.—Here there is suppuration in the pelvis of the kidney, which, in addition, may be dilated and converted into a bag of pus. This condition arises in connection with some obstruction to the escape of urine from the kidney.

We shall only describe the most common conditions that the surgeon meets with—namely, suppurative pyelonephritis and pyonephrosis; should he be called upon to deal with a case of true *suppurative pyelitis*, the treatment will be directed to removing the cause. The organism met with in these cases is generally the colon bacillus; sometimes the gonococcus is the active agent, while in the more severe cases the ordinary pyogenic cocci or the typhoid bacillus may be present either alone or in combination with the colon bacillus. When the affection is due to the colon bacillus alone it is apparently not so acute as when the pyogenic organisms are also present.

PYELONEPHRITIS.

In the great majority of these cases the inflammation is secondary to disease in the lower part of the urinary tract. Thus it frequently occurs in connection with some long-standing obstruction to the escape of urine from the bladder—such as enlarged prostate or stricture of the urethra—accompanied by infection of the urine. Occasionally it may originate from obstructions higher up, such as a calculus or a stricture in the ureter. It may also supervene on paralysis of the bladder in cases of spinal disease or injury, and may follow the introduction of instruments into the bladder. It may also originate in the kidney itself by the deposit of organisms from the blood or the lymph stream or possibly by direct migration of bacteria from the colon or from an inflamed appendix lying over it.

When the affection originates from below, one kidney alone—generally the right—is usually involved in the first instance, and in any case the condition is more advanced on one side than on the other. Before suppuration occurs there may be evident effects of backward pressure, such as distension of the ureter and the renal pelvis, and this diminishes the resisting power of the tissues to the micro-organisms, which gain access to the pelvis subsequently; it also facilitates the inflammation, as it keeps up congestion of the kidney. When this condition of affairs is present, it is obvious that the introduction of micro-organisms into the bladder by instruments is a source of grave danger.

The pelvis of the kidney and the ureter are in a state of chronic inflammation with much thickening, and pus forms in their interior.

The ureter, which may be much thickened, may be diminished in calibre, and not distended, unless there is an obstruction below. There are patches of inflammation and frequently small abscesses throughout the renal cortex.

The affection may be either acute or chronic. In acute cases, death occurs rapidly from suppression of urine or from pyæmia or septicæmia. The chronic form may last for months or even years.

Symptoms.—*In the acute form*, the onset of the disease is generally marked by severe rigors, with high temperature, and vomiting. The patient soon passes into a typhoid state and dies in the course of two or three weeks, unless the disease is arrested. Death is often preceded by coma, with uræmic convulsions.

In the more chronic form—generally spoken of as ‘surgical kidney’—the onset of the affection is often insidious; the elevation of temperature is slight at first, and the patient only complains of digestive troubles. There may be pain or uneasiness in the loin, and sleeplessness, often accompanied by slight delirium. The temperature soon becomes irregular and intermittent. Examination of the urine—which at first may be acid, but later on becomes alkaline—shows the presence of pus; in the early stages there is often polyuria and increased frequency of micturition. Albumen is present, but is usually accounted for by the pus; epithelial cells from the renal pelvis may also be found in the urine. Later on, renal casts may be present, and the kidney is tender, but not necessarily enlarged; when it is enlarged, pyonephrosis is probably present.

When the temperature is high at night and assumes a hectic type, and the patient loses flesh and has profuse perspirations, a quick pulse, nausea, and occasional rigors, the condition is strongly presumptive of ‘surgical kidney’—especially if the patient is suffering from prostatic disease, stricture of the urethra, or cystitis.

It is sometimes difficult to diagnose this affection from renal tuberculosis, but in that disease there is nothing to account for the onset of the pyelonephritis, while there may be tuberculosis elsewhere, occasional hæmaturia without any obvious cause, and perhaps tubercle bacilli in the urine.

The distinction between pyelonephritis and simple pyelitis is by no means easy to make, but in the former condition the symptoms are usually more severe. Many cases of pyelonephritis begin as a simple pyelitis, and the treatment is practically the same in the two conditions, unless operative treatment seems indicated.

TREATMENT.—The possibility of the occurrence of these conditions must be borne in mind in all cases of inflammatory disease in the lower part of the urinary organs or when obstruction to the outflow of urine is present, and these conditions should, if possible, be corrected. The worst cases are those which occur in connection with enlarged prostate or paralysis of the bladder; when these affections are present, patients

often die of suppurative pyelonephritis owing to the difficulty of preventing the occurrence of sepsis in the urine. In prophylaxis it is essential to ensure asepsis in connection with any instrumental or operative interference; if the urine is undergoing decomposition, measures must be taken to render it aseptic. The precautions requisite in operating on the lower urinary tract, and the best methods of diminishing the septic condition of the urine are referred to in connection with diseases of the bladder and the prostate.

When inflammation of the renal pelvis or of the kidney has set in, the first essential is absolute rest in bed; the diet should be light and restricted—in bad cases entirely liquid—and the urine rendered dilute. The bowels should be kept open by salines; the slightly diuretic mineral waters, such as those of Contrexéville and Vichy, may be useful. Lumbar pain is best relieved by hot baths or fomentations; in bad cases dry-cupping over the loin, or the application of leeches (see Vol. I. p. 5) may be useful. Internal antiseptics, such as salol, benzoate of ammonia, cystopurin, or boric acid in ten-grain doses, seem to do good in some cases and may be tried, but their effects must be watched, as they may not only upset the stomach, but irritate the kidney and aggravate the pain; boric acid is apt to irritate the stomach, and if it does, it may be administered in capsules. Quinine, in doses of five grains, three times a day, either in a pill or floating on milk, is valuable. The more chronic cases benefit from residence in a warm climate, where chills and congestion of the kidney are comparatively easily avoided. The bladder must be washed out if there is decomposition of the urine. Vaccines—preferably, autogenous ones—are much used at the present time.

These measures often lead to marked improvement and may entirely cure a pyelitis. They are practically the only ones that can be adopted in a case of 'surgical kidney,' seeing that both organs are practically always affected, and that nephrectomy is therefore not advisable.

A circumscribed abscess of the kidney is occasionally met with, but rarely diagnosed. In such a case, the obvious treatment is incision and drainage. It may happen that an abscess of this kind is found in connection with calculi in the substance of the kidney, or when the organ is cut down upon under the impression that a renal stone is present.

PYONEPHROSIS.

In this condition there is suppuration in the renal pelvis and calyces accompanied by dilatation of these structures. It may arise under three different sets of circumstances: an existing hydronephrosis may become infected and suppuration may occur in it; suppuration and dilatation may commence simultaneously in a case of obstruction low down in the urinary passages accompanied by infection of the urine; or the pyelitis

may precede the dilatation, and in this case the distension of the pelvis is due not so much to mechanical obstruction in the bladder or urethra as to blocking of the ureter by pus and clot or calculi. The most frequent cause of pyonephrosis is renal calculus. The condition may also arise from the pressure of tumours on the ureter, from vesical affections, such as stone, papilloma and malignant disease, or from urethral or prostatic obstructions. It is very common in tuberculous renal disease (see Chap. LIV.). The septic infection may be due to an ascending infection secondary to the dilatation, or it may be derived from the blood or the lymph stream.

The kidney is frequently enlarged and lobulated owing to the distension of its calyces. The loculi communicate with one another and with the distended renal pelvis, whilst the renal cortex undergoes sclerosis and atrophy; the septa between the various loculi may be dense and fibrous or may be destroyed. The interior of the renal pelvis is frequently lined with a phosphatic deposit, which may give rise to a diagnosis of stone when a radiogram is taken.

The condition is often unilateral when it is due to renal calculus, but it may be bilateral when it is due to obstruction to the outflow of urine from the bladder. After a time, peri-nephritis occurs, and the kidney becomes bound down to the structures in its neighbourhood. A peri-nephric abscess may occur from the spread of infective organisms through the wall of the renal pelvis into the fatty capsule without any fistulous communication, or may arise from a direct communication between the pelvis of the kidney and the surrounding structures. When the affection is due to a calculus, the distension of the pelvis may be intermittent; when the distension is greatest there may be no pus in the urine, but this will be followed by profuse pyuria as the distension subsides.

In addition to the *symptoms* of pyelitis there is a tumour in the loin, and frequently profuse intermittent pyuria; the tumour is nodular and may be elastic. The condition of the urine varies according as the communication between the kidney and the bladder is free or not. In most cases there is a certain amount of pus in the urine; in some, the amount is large, in others the pyuria is of an intermittent type, and in them the cause is probably a stone acting as a ball-valve in the pelvis. The reaction of the urine is usually alkaline, and there is much mucus; the urine may, however, be strongly acid and in that case the bacillus coli may be present in large numbers. There is often a history of previous attacks of renal colic.

This condition cannot well be mistaken for hydronephrosis, in which there is no pyrexia or pyuria. It may, however, be difficult to distinguish it from a peri-nephric abscess accompanied by pyelitis, but the most difficult point is to diagnose a calculous pyonephrosis from a tuberculous kidney; a radiogram may possibly clear up the matter, but

the presence of much phosphatic deposit in the tuberculous cavities may be very baffling. One of the most helpful points in the diagnosis of pyonephrosis is the discovery of a cause of obstruction to the outflow of the urine. The lower urinary passages must be examined, and stricture of the urethra, enlargement of the prostate, vesical stone, or a pelvic tumour, must be looked for.

The prognosis depends on the cause of the distension and the possibility of its removal, and also upon the condition of the opposite kidney. If the latter is healthy and the cause of the distension removable—as, for instance, a stone—the prognosis is good; if the cause is irremovable or the other kidney affected, it is very grave.

TREATMENT.—Palliative.—When the condition is not urgent enough to demand immediate operation, or while the exact cause of the mischief and the condition of the opposite kidney are being ascertained, general treatment, such as that already recommended for pyelonephritis, should be employed (see p. 549), and should be persisted in, while at the same time any obstructive condition in the lower urinary passages is being attended to.

Of recent years, much comfort has been given to the patient and some considerable benefit secured by washing out the pelvis of the affected kidney by means of the ureteral catheter. This must necessarily be a method of treatment that cannot be carried out by many surgeons, but it should be borne in mind.

When the condition is due to mischief in the kidney, such as a stone, or when obstructive conditions lower down in the urinary tract have been rectified without improvement in the renal condition, the question of dealing directly with the kidney will arise. Time should not be wasted on palliative measures if they do not produce improvement, especially when there is much pyrexia.

Operative.—This takes the form of either simple nephrotomy and drainage, or nephrectomy. The object of the former operation is to drain the abscess and remove the obstructing cause if possible. In most cases the first thing to be done is a nephrotomy, and the question of nephrectomy will only arise under certain circumstances.

Nephrotomy.—The kidney is exposed in the usual manner, as for nephro-lithotomy (see p. 565), isolated, and brought out on the loin, the tissues around are packed off, and the kidney is incised a little behind its convex border; the finger is then introduced into the pelvis, and if a stone is found it is removed (see Chap. LV.). If no stone is found, a probe is passed down the ureter, and an impacted stone or a stricture searched for and dealt with appropriately.

Drainage will be necessary after removal of the obstruction if a fair amount of healthy renal tissue is left. A large tube is fixed in the pelvis of the kidney, the original packing is removed; and fresh gauze is tucked in around the tube. When a peri-nephric abscess is present in addition

to a pyonephrosis, a tube should be passed behind the kidney in addition to the one into the pelvis.

After-treatment. — The dressings should be frequently renewed, because urine, as well as pus, will escape through the loin. If the cause of obstruction has been removed and there is no obstruction in the ureter, rapid improvement generally follows, the urine escaping partly through the loin and partly into the bladder, and the amount escaping from the loin will gradually diminish. As soon as urine passes freely into the bladder and the amount of pus diminishes, the drainage tube may be shortened, but even in favourable cases it will be three or four weeks before this can be done, and after that a renal fistula may remain for several months. Should healing not have occurred at the end of six months, the case must be looked upon as one of permanent renal fistula, and treated accordingly (see Chap. LV.). The patient should be kept in bed for the first six or eight weeks, but at the end of that time, he may be allowed to get up, wearing a lumbar urinal, if the temperature has fallen and the general condition has improved. It will be necessary to use a drainage tube passing into the peri-nephric tissues, in order to keep the external opening patent until the deeper part of the wound closes.

Nephrectomy.—Sometimes it is obviously hopeless to expect nephrotomy and drainage to effect a cure, and a primary nephrectomy will then be called for. This will be necessary, for example, when there is a cicatricial stricture of the ureter which cannot be overcome, so that nephrotomy and drainage would certainly end in a permanent renal fistula. Moreover, the kidney may be so disorganised that little secreting substance is left and the organ is useless. When this is the case, and there is reason to believe that the other kidney is healthy, primary nephrectomy is indicated. The proper treatment, however, in the majority of cases—in the first instance, at any rate—is nephrotomy and drainage; this has the advantage that, even should nephrectomy become necessary, the condition of the other kidney may be inferred from the character of the urine passing through the bladder, as the secretion from the affected kidney will probably all pass through the loin in the first instance, and the two may thus be differentiated. Should the opposite kidney be markedly affected also, the patient must put up with a permanent renal fistula.

The operation for removal of the kidney in these cases is very similar to lumbar nephrectomy for renal calculus (see Chap. LV.). A secondary nephrectomy is much more difficult than a primary one, as there will be adhesions to surrounding parts. Great difficulty may be met with in dealing with the renal pedicle on account of its shrinkage and the presence of adhesions. The ureter should be isolated separately, and the lower end brought out into the lower angle of the wound, the cut surface swabbed with undiluted carbolic acid, and either stitched

into the wound, or invaginated and sutured. If the matting of the structures in the hilum of the kidney is extreme, it may be necessary to put a temporary ligature round the pedicle, cut the kidney away in front of this, and then clear and tie the vessels separately; free drainage must be employed. The after-treatment is similar to that for nephrectomy for stone (see Chap. LV.).

CHAPTER LIV.

TUBERCULOSIS OF THE KIDNEY AND URETER.

THE kidney is one of the most common seats of genito-urinary tuberculosis, and the disease may be primary or it may be secondary to tuberculous disease elsewhere. In primary renal tuberculosis, the organisms reach the part through the circulation, and the affection usually begins in the renal cortex, whereas the secondary form is an ascending affection and attacks the renal pelvis in the first instance. It is most common between the ages of twenty and thirty, and seems to be more frequent in women than in men. The affection is generally limited to one kidney in the first instance; when both sides are affected, the disease is more advanced on one side than on the other. It is predisposed to by previous renal disease, such as nephritis or pyelitis, by blows on the loin, and alcoholism.

The tubercles are deposited about the bases of the papillæ, and spread both towards the capsule and the renal pelvis. The tuberculous masses soften, forming cavities containing cheesy material, which after a time burst and discharge their contents into the pelvis of the kidney and thence down the ureter. When this happens, the mucous membrane of the renal pelvis becomes the seat of tuberculous disease, and may subsequently become dilated. As the disease advances, the kidney becomes progressively disorganised, until finally it consists of a series of cavities containing cheesy material.

The affection spreads from the kidney to the ureter, which may become markedly thickened and diminished in calibre from the deposit of tubercles in its walls; this leads to interference with the outflow of the urine. Phosphatic masses are often deposited on the cheesy material in the renal pelvis and form renal calculi, so that a combination of tuberculosis with a calculous condition is not infrequent. A mixed infection with the bacillus coli or the pyogenic cocci very frequently supervenes. The capsule becomes thickened and adherent, and peri-nephritis occurs and fixes the kidney—an important point in operating, as the pedicle may become shortened, and the vena cava may lie close beside the kidney and may be injured during nephrectomy.

The symptoms vary according to the stage of the disease and its mode of onset. In primary infection from the blood-stream there are practically no symptoms in the early stages. The first signs are pain in the loin—usually moderate in amount and not much influenced by movement—frequent micturition, and polyuria, together with some diminution in the amount of urea and phosphates. Another early symptom is hæmaturia which may occasionally be severe and prolonged, but which is generally small in amount, often requiring microscopical examination for its detection. It appears without apparent cause and is not increased by movement or improved by rest.

As the affection progresses, the pain in the loin becomes severe and of a lancinating or boring character. Attacks of renal colic occur and are probably due to the passage of caseous masses along the ureter, and occasionally there may be intermittent hydronephrosis. The kidney becomes tender and enlarged; in some cases this is the first symptom noticed. The organ may retain its normal outline, but it more often presents a lobulated character. As the disease advances, the urine contains pus, blood, and often débris and cheesy particles; when there is a mixed infection the amount of pus may be very large. Sometimes there is albuminuria out of proportion to the amount of pus, and this indicates the existence of chronic nephritis or waxy degeneration. The tubercle bacillus may be found in the urine after centrifugalisation, or by inoculating guinea-pigs. Sometimes there is severe dysuria, which may lead to an erroneous diagnosis of disease of the bladder. It is, however; not uncommon for a chronic non-tuberculous cystitis to be set up by the passage of the tuberculous material and pus; there may also be coexisting tuberculous disease of the bladder. When the ureter is much thickened, it may be felt through the abdominal walls in a thin patient, or the lower end may be felt through the vagina in the female.

In the early stages the patient's general health remains fairly good, but later on there is loss of flesh, accompanied by hectic fever and night sweats, and there may be marked toxic symptoms, such as anorexia and vomiting, and finally symptoms of septicæmia or pyæmia. The more severe symptoms are probably due to secondary pyogenic infection rather than to the tuberculous disease itself.

The diagnosis in the early stages may be extremely difficult. Should the tubercle bacillus be found in the urine, the nature of the disease is certain; but in its absence the frequent micturition and the pain in the loin, both of which are unaffected by rest, together with the presence of pus and blood in acid urine, hectic fever, progressive loss of flesh, enlargement of the kidney, and possibly tuberculosis elsewhere, will generally lead to a correct diagnosis. The hæmaturia of renal tuberculosis is not likely to be confounded with that of stone, as it is much slighter in degree and is uninfluenced by movement; nor should it be confounded with

that due to a renal growth, which is generally profuse. Important information may be gained by the help of the cystoscope. Thus the ureter on the affected side may be swollen and prominent and the pus may be seen coming from it. Also there may be a few tubercles seen in the bladder in the region of the ureter. Occasionally, the ureteral papilla is converted into a deep conical cavity, apparently from drawing up of the papilla by traction on the ureter.

Important points which have to be investigated before deciding upon treatment are which kidney is affected and whether the other kidney is healthy; these questions are discussed in Chap. L.

TREATMENT.—This may be either non-operative or operative.

(a) **Non-operative.**—This is mainly the ordinary treatment of tuberculosis (see Vol. I. p. 231). Among drugs, creosote (15 to 20 minims, three times a day) and iodoform (in one-grain pills), are most useful. Tuberculin may also be employed.

(b) **Operative.**—From the earliest period the question of operative interference must be considered. If time is lost, the bladder or the other kidney may become affected.

The surgical procedures available are the following:—

Nephrotomy followed by drainage of the pelvis of the kidney, with removal of as much of the tuberculous material as possible. This may be the only method adopted or it may be a preliminary to a secondary nephrectomy.

Partial nephrectomy, in which only the diseased portion of the kidney is removed.

Complete nephrectomy, accompanied by removal of as much of the ureter as is diseased.

The choice between these procedures will be influenced by the condition of the other kidney, the bladder, and the patient.

Nephrotomy.—Nephrotomy is indicated when the patient is so ill that something must be done, but is so weak that nephrectomy is out of the question; when the other kidney is so extensively affected, that the removal of even a small amount of secreting kidney tissue is not justifiable; or when there is marked vesical tuberculosis, for here the symptoms will not be materially relieved by nephrectomy, and, moreover, the other kidney will almost inevitably become affected before long. Another indication is the coexistence of a peri-renal abscess with the disease in the kidney.

The operation is performed in the manner described on p. 519. The caseous material is scraped away with a flushing-spoon and a large drainage tube is introduced. Considerable improvement may follow this procedure and, when the patient's condition has improved, nephrectomy may be performed—provided that the kidney operated upon is the sole seat of disease. Simple nephrotomy practically never leads to a cure, nor can it be depended upon to prevent the spread of

the disease, because pus and urine still escape into the bladder in spite of drainage of the renal pelvis. In some cases, however, shrinking of the organ and quiescence of the disease may ensue, but the best that can be hoped for is diminution of the hectic fever and the other symptoms due to the retention of decomposing pus.

Partial nephrectomy.—When the kidney has been cut down upon and the tuberculous lesion is found to be limited to one part of the kidney, the affected portion may be excised by removing a wedge-shaped portion containing the diseased area ; the cut surfaces of the remaining portion of the organ are approximated by deep sutures (see p. 533). In some instances benefit has followed, although in several it has been found necessary to remove the rest of the kidney subsequently. The possibility of this procedure must be kept in mind when a tuberculous kidney is exposed, for, if it is practicable to remove the disease and at the same time leave a sufficient amount of useful kidney tissue behind, one great objection to nephrectomy is removed.

Complete nephrectomy.—This is the ideal operation, but the other kidney must be sound before its employment is justified ; the bladder and the peri-renal tissues must also be free from disease, and the patient in a fair condition to stand the operation. The most important point is the condition of the opposite kidney, and to determine this the ureters must be catheterised and the urine from each kidney collected separately and tested for tubercle bacilli, and the renal function must be carefully estimated. These matters are discussed in Chap. L.

Nephrectomy for tuberculosis is best done through a lumbar incision which gives plenty of room for the removal of any tuberculous kidney requiring it ; by extending the incision downwards and forwards the greater part of the ureter can be removed at the same time if necessary. The kidney is exposed and brought out on the loin in the usual manner (see p. 565), and the ureter is traced down until a healthy portion is reached—even if the wound has to be extended for the purpose—and is ligatured in two places and divided between the ligatures. Before division of the ureter, gauze should be packed around it so as to prevent infection by any pus which may be present between the ligatures. If the divided distal end of the ureter is apparently healthy, it should be touched with undiluted carbolic acid and the end turned in and closed by catgut stitches. The pedicle of the kidney is now ligatured in the usual manner, the ureter not being included, and the organ is removed along with the ureter ; in this way no pus should escape into the wound. The wound is closed in the usual manner, a drainage tube being inserted for a few days.

Should there be evidence of tuberculous mischief lower down the ureter, the remainder of that tube must be dissected out, either immediately or at a subsequent operation, according to the patient's condition. If the patient is suffering from severe shock, the ends of

the ligature upon the distal portion of the ureter should be left long and brought out of the lower end of the wound, the upper portion of which should be closed. Some days later, when the patient has recovered from the shock, the remainder of the ureter may be dissected out; the ends of the ligature will act as a guide to the tube. It is always well to remove a diseased ureter even though this may involve a second operation, otherwise a permanent lumbar fistula is almost certain to occur, and the disease may infect the bladder and so spread down the genito-urinary apparatus.

In order to remove the ureter at the time the nephrectomy is done, the lumbar incision is carried downwards and forwards as far as may be necessary to enable the surgeon to reach the ureter in the pelvis. The peritoneum is then turned forwards and stripped off the ureter, which is tied in two places as near the bladder as possible, the stump being treated in the manner described above and a drainage tube inserted down to the seat of its division. When the patient is not well enough to stand this prolongation of the kidney operation, the original wound in the loin need not be opened up again at the subsequent operation, but the lower part of the ureter is identified and divided as low down as possible, by one of the procedures described on pp. 572 *et seq.*

After-treatment.—If suppuration does not occur in the wound, the drainage tubes may be left out in four or five days, but the patient should be kept in bed for three to four weeks so as to allow the incision in the lumbar wall to become firm. Paralysis of a portion of the rectus may follow extensive division of the abdominal wall, and if it does, the patient will have to wear a suitable abdominal belt.

If the disease is early and limited to one kidney and ureter, there may be no further trouble in the majority of these cases, and the bladder and other kidney may remain sound. Even if there are a few tubercles in the bladder they may disappear when the infective discharge from the kidney ceases. A few doses of tuberculin, or of Mehnarto's contra-toxin, may be given after the operation. The immediate mortality of the operation should be small.

CHAPTER LV.

RENAL AND URETERAL CALCULUS: SUPPRESSION OF URINE: RENAL FISTULA.

RENAL CALCULUS.

RENAL calculi may be formed in the uriniferous tubules, the calyces, or the renal pelvis. The commonest form consists of uric acid; next in order of frequency come those of oxalate of lime, then those composed of urates and, much more rarely, phosphate or carbonate of lime, cystine or xanthic oxide calculi. The so-called 'secondary calculi' that are deposited in a diseased kidney are mainly composed of phosphates and carbonate of lime. The nucleus of the calculus may be crystalline or may consist of blood-clot, mucus, or caseous material. When septic changes occur in the urine, alkaline phosphates are deposited and form an outer coating to the calculus.

The calculi may be multiple or single; oxalate of lime stones are generally single. They may be rough or smooth, roundish or oval, or branched corresponding with the calyces of the kidney. The stone may be movable or fixed; massive branched calculi are usually fixed, whereas the small round ones may move freely in the renal pelvis, and cause temporary obstruction to the flow of urine by blocking the orifice of the ureter. Calculi are sometimes embedded in the renal parenchyma.

Calculi may occur simultaneously in both kidneys or in one organ after the other; they are, however, most often present on one side only. They are not common between twenty and forty years of age, and are quite rare in children. A sedentary life, debility, the use of hard drinking-water, excesses in diet, inflammatory conditions of the renal pelvis, or septic conditions of the urine in the case of phosphatic calculi, are amongst the chief causes. They are said to occur most often in dyspeptics and neurasthenics, and are more common in males than in females.

A renal stone must be got rid of either by passing along the ureter into the bladder or by a surgical operation, as no attempt to dissolve a fully formed calculus seems to be successful. The stone causes damage to the kidney in several ways. It sets up a chronic nephritis which diminishes the secreting power of the organ, and the inflammation may extend to the capsule and give rise to peri-nephritis with adhesions, or to peri-nephric suppuration. When in the pelvis of the kidney, the stone may block the ureter and give rise to distension of the pelvis and calyces. Occasionally, true hydronephrosis results, but this is rare, as the blockage is usually temporary. A stone may pass into the ureter and block it, in which case it gives rise to distension of the pelvis, and in some cases to complete suppression of urine from reflex action.

Sepsis generally occurs after a time, and suppurative pyelitis, pyelonephritis, or pyonephrosis then sets in. A kidney that has long been the seat of stone may be converted into a mere bag of pus containing one or more stones. When suppuration has taken place in the kidney, peri-nephric abscess may follow, and open in the loin and lead to a fistula, while occasionally the stone escapes into the peri-renal tissues and is found in the abscess cavity. The prognosis of renal calculus is therefore very serious and, as a rule, the sooner measures are taken to remove a stone the better it is for the patient.

The classical *symptoms* of uncomplicated cases of renal calculus are pain and hæmaturia. The *pain* is fixed and persistent, and may be either a dull aching in the affected loin or a more severe pain, causing the patient to keep the affected side rigid on stooping or moving; it is aggravated by exercise, and generally subsides on lying down. When there is much pain there is also, as a rule, tenderness on pressure over the affected kidney, with reflected pain down the ureter and into the thigh and testicle on the affected side. The pain may be occasionally referred to the bladder and there may be frequent and painful micturition which may lead to a mistaken diagnosis of vesical calculus.

One of the commonest symptoms is an attack of *renal colic*. A small stone may pass along the ureter without causing much trouble, while a large one may remain in the kidney without giving rise to any marked symptoms. Stones of intermediate size, however, pass into the ureter and there give rise to a series of symptoms known as renal colic. Renal colic is nearly always due to the passage of a calculus, but it may arise from the passage of a clot along the ureter, or even from kinking of that structure in cases of movable kidney. The symptoms of typical renal colic are a sudden attack of *violent pain* shooting down the course of the ureter and felt in the bladder, the groin, and the testicle on the affected side. It is paroxysmal, and often so excruciating that the patient screams and is doubled up by it. In the male, the testicle may be retracted and tender. The attack may be ushered in by a rigor, and is generally accompanied by vomiting or retching, faintness, and

collapse. The urine is diminished in quantity and may be blood-stained and loaded with urates, and there is often a feeling of scalding in the urethra. The bladder is irritable, and the urine is passed frequently. In some cases, there is a high temperature and great mental prostration, whilst the kidney and ureter are tender on palpation. Suppression of urine may occur either from blockage of both ureters by stones, or from reflex action caused by the presence of a stone on one side. When the stone reaches the bladder, the attack frequently passes off quite suddenly; if the calculus becomes impacted in the ureter, the acute pain ceases, and a dull aching in the region of the kidney or the ureter is left behind. Sometimes the stone slips back again into the renal pelvis.

Hæmaturia is frequently, but by no means constantly, present. It is comparatively slight in amount, and the blood is usually intimately mixed with the urine, but occasionally clots are passed which have the shape of the ureter or the renal pelvis. The bleeding is aggravated by movement, and diminished by rest.

Pus is generally found in the urine on microscopic examination and may be considerable in quantity when there is suppuration in the renal pelvis. The urine as a rule is acid and not offensive, except when there is severe pyelitis. *Albuminuria* is nearly always met with, but is usually accounted for by the pus present. There is *enlargement of the kidney*, ascertainable by palpation in a certain number of cases, especially in the later stages when there is suppuration in the renal pelvis.

The *diagnosis* of stone in the kidney is not always easy. The pain may be confounded with that due to lumbar neuralgia, but in the latter case there is usually an entire absence of tenderness over the kidney. Neuralgia of the kidney is often present when the organ is movable; in this case the absence of any hæmaturia, and the mobility of the organ will usually clear up the diagnosis. Renal neuralgia, accompanied by hæmaturia, may be due to malarial poisoning, and is a source of great difficulty in diagnosis; examination of the blood, and a consideration of the temperature and the history of the patient should, however, lead to a correct diagnosis. Intermittent hydronephrosis may be mistaken for renal colic, and so may appendicitis, especially the type known as appendicular colic. It is sometimes difficult to diagnose a renal calculus from renal tuberculosis (see p. 556), more especially as deposit of phosphates takes place upon the caseous material in some of the latter cases, so that a sort of stone is actually present. Biliary calculi may coexist with renal stones.

A renal growth is distinguished from renal calculus by the absence of a history of colic and of pus in the urine, and by the fact that the hæmaturia is not only profuse but apparently causeless, and is not improved by rest, while the increasing size of the kidney will soon clear up the diagnosis. Renal embolism from heart disease has also given rise to difficulty in diagnosis. Paroxysmal renal pain of unknown origin

may closely simulate renal calculus, and the kidney has been exposed a number of times for this condition and nothing found.

When a patient suffers from gravel—that is to say, the passage of groups of crystals down the ureter—all the symptoms of renal calculus may be met with. Here a course of treatment, with the view of diluting the urine and diminishing the formation of the particular crystals, will clear up the diagnosis, as the condition subsides entirely.

At the present time much help may be afforded by the X-rays. Different forms of stone, however, vary in penetrability; for example, a uric acid stone gives a faint shadow, whilst the oxalate stones give a well-marked one. In stout patients the thickness of the tissues may interfere with a satisfactory result, and in any case a skilled radiographer must be consulted. There are many fallacies connected with the use of the X-rays. For instance, definite shadows, closely resembling those of stones, may be given by phosphatic concretions upon an inflamed renal pelvis or in old tuberculous cavities or masses. Calcified glands and inspissated tuberculous pus may also cast shadows that may be mistaken for stones. The bowel must always be emptied completely before the photograph is taken, and it is well to pass an opaque ureteral bougie up to the pelvis of the kidney if there is any doubt as to the significance of a shadow. In doubtful cases, radiograms should be taken on different occasions in order to see whether the result varies, as the shadows cast by the stones are frequently so faint as not to be characteristic, and imperfections in the plate may easily give rise to appearances which may be mistaken for a stone if only one photograph is taken. In all cases in which a stone is small, a radiogram should be taken immediately before the operation, as cases are known in which the stone has passed from the renal pelvis into the ureter or even the bladder in the interval between the examination of the patient and the operation.

In cases of renal calculus, as in those of tuberculosis, an important point is the determination of the condition of the opposite kidney, and in renal calculus, moreover, it is obviously very important to know upon which side the stone lies. It is said that occasionally the pain due to a renal calculus is referred to the healthy kidney, and not to the side on which the stone is; this must, however, be extremely rare, and in practice one is almost safe in deciding that the mischief is situated on the side to which the pain, tenderness, and attacks of renal colic are referred. The condition of the opposite kidney, although of importance, does not however, influence the question of operative interference for the removal of the stone; indeed, the presence of disease rather adds to the urgency of the operation. The condition of the second kidney is, however, most important if, on performing nephro-lithotomy, the affected kidney is found to be disorganised, and to require removal. This point is discussed in Chap L.

TREATMENT.—(a) Preventive.—The surgeon is often asked by patients who have had attacks of renal colic followed by the passage of small calculi, but in whom there is no evidence of the presence of a stone, what they can do to prevent the formation of a fresh calculus.

The preventive treatment of stone is largely hygienic and dietetic. A due amount of exercise, such as bicycling, horse-riding or walking, should be prescribed, and the action of the skin should be promoted both by friction and by the occasional use of a Turkish bath. Excess of nitrogenous food, both vegetable and animal, must be avoided, and the diet should be quite plain. Alcohol should be prohibited, with the exception perhaps of a little whisky and water,

When the urine contains an excess of *urates*, alkaline diuretics—such as bicarbonate of potash or soda, citrate of potash or lithia, benzoate of ammonium, and acetate of potash—may be prescribed. Urotropine is said to be a solvent of uric acid as well as an antiseptic and a diuretic, and may be given in ten-grain doses; cystamine in five-grain doses is a good substitute. The patient should keep his urine diluted by drinking plenty of water; the mineral waters of Vichy, Royat, or Contrexéville are much in favour, and he may with advantage spend some weeks each year at one of those watering-places. It is important that the bowels should be regulated.

When there is an excess of *phosphates*—phosphaturia—the above treatment is not efficacious. Any alkaline dyspepsia must be corrected. A generous diet, and treatment suitable for neurasthenia should be adopted. If the phosphaturia is due to pyelitis, this must be treated (see p. 550). Mineral acids, strychnine, bitter infusions, quinine, and preparations of iron are the most useful drugs; antiseptics, such as urotropine, salol, and boric acid, in ten-grain doses thrice daily, may be called for when there is decomposition of the urine.

In the *oxalic acid diathesis*, fresh air and exercise are of importance. Vegetables rich in oxalic acid, such as asparagus, tomatoes, rhubarb, or gooseberries should be avoided. Plenty of diluents are indicated, and stimulants are sometimes of value. Nitro-hydrochloric acid, bitter infusions, strychnine, quinine, and preparations of iron are the drugs generally prescribed. Contrexéville, and other waters containing lime, should be avoided.

(b) Palliative.—When small calculi are present, the above measures are also of value, and should be employed until it is obvious that the stone will not pass or that the kidney is becoming damaged by it and that therefore more radical surgical treatment is called for. It sometimes happens that a course of medical treatment causes the symptoms to disappear, and although probably in most of these cases the condition is one of gravel rather than of actual stone, it may happen, nevertheless, that a small stone may have its surface rounded off and may thus pass more readily down the ureter. When the diagnosis is

clear, however, operation must not be delayed until the kidney becomes seriously damaged.

(c) **Operative.**—When the symptoms point to the existence of a stone too large to pass down the ureter, surgical intervention should be undertaken in order to prevent disorganisation of the kidney. The choice lies between nephro-lithotomy and nephrectomy.

Nephro-lithotomy is the ideal operation for all cases of stone, and it is only when the surgeon finds during the course of the operation that it will manifestly not meet the requirements of the case that nephrectomy should be resorted to. On the other hand, a disorganised kidney which is a mere abscess cavity devoid of renal structure clearly requires *nephrectomy*, as a nephro-lithotomy would probably give rise to a permanent fistula, and the patient would also run risks from sepsis. Nephrectomy must likewise be done if the ureter is occluded and there is no chance of restoring its lumen; these cases, however, are rare. For these conditions, the operation will be a primary nephrectomy, but a secondary nephrectomy may be called for when a permanent lumbar fistula is left after a nephro-lithotomy and the other kidney is evidently healthy; the patient will probably insist on the affected kidney being removed because of the serious inconvenience it causes. It is important that the nephrectomy should be a primary one if possible, as a secondary nephrectomy is generally very difficult and more dangerous than a primary one, owing to the dense adhesions. In all other cases, nephro-lithotomy is the operation of choice, and it must be the operation of necessity when the opposite kidney is known or suspected to contain calculi or is markedly diseased, in which case it is most important to restore one kidney to health as soon as possible.

Nephro-lithotomy.—The preparation and position of the patient are the same as for nephropexy (see p. 519). It is well to have the radiogram displayed close to the operating-table so that the results of the operation can be compared with the condition shown by the photograph. The incision commences just over the outer edge of the erector spinæ, runs parallel to and nearly an inch below the lower border of the last rib, and extends nearly to the level of the anterior superior iliac spine whence it can be prolonged downwards if a stone is present in the upper part of the ureter (see p. 572). It is well not to divide the muscles and soft parts too freely until the condition of the kidney has been ascertained; the parts can be opened up afterwards as widely as may be necessary. Additional room is rarely required in these cases, but it may be wanted when nephrectomy is found to be necessary or when the patient is very fat, and it may be obtained by carrying a vertical incision upwards over the twelfth rib; this, however, will not often be required if the costo-vertebral ligament is divided; this ligament is derived from the anterior layer of the transversalis aponeurosis, and runs from the tips of the first and second lumbar transverse processes to the twelfth rib, or to the

eleventh when the twelfth is rudimentary. Excision of the last rib may be necessary in some cases, and greatly facilitates removal of the kidney ; the outer edge of an unduly broad quadratus lumborum may require partial division. The last dorsal and the ilio-hypogastric nerves should be avoided if possible, but, if they must be divided, a portion should be excised in order to prevent the ends being caught in the cicatrix.

The fatty capsule of the kidney is exposed in the same manner as in nephropexy (see p. 519). The assistant makes firm pressure from the front, and the kidney is freed from the surrounding structures, so that it can be extruded from the wound. The organ should first be cleared below, and the separation carried forwards until the ureter is reached, when a strand of gauze should be passed behind the ureter and pulled forward so as to kink it and prevent the escape of a small stone downwards during the manipulations. If possible, the kidney should always be brought out of the wound, as it enables it to be much more thoroughly examined, and the removal of the stone is greatly facilitated. This, however, may be impossible, owing to extensive peri-nephritis, and the structure in the hilum may have undergone so much shrinkage as to render traction upon the pedicle dangerous.

The pelvis and substance of the kidney must be palpated, and if a stone of any size is present in the pelvis it will be detected and can be cut down upon directly through the wall of the pelvis. If, however, no stone is detected on palpation, the kidney must be incised in order to examine the interior of the organ ; needling is not only of little value but wastes time, because the kidney must always be incised before the operation is completed.

While the kidney is being incised, the pedicle should be compressed in order to control the bleeding and prevent any calculus falling into the ureter. The incision should be long enough to admit the finger, and is made a finger's breadth behind the convex border of the kidney, where the anterior branches of the renal artery meet the posterior ones and the vessels are smallest. The incision is deepened into the pelvis of the kidney, the interior of which is examined by the finger introduced through the opening. If the finger fails to detect a stone, the incision in the renal parenchyma is enlarged upwards and downwards so as to lay the pelvis of the kidney freely open, when it will be quite easy to detect any stone or stones present either by sight or by touch. When this is being done the bleeding is very free, but may be controlled by grasping the pedicle firmly ; a thorough examination of the various calyces should be made *seriatim*.

Finally, the ureter is examined, first by palpation as far as it can be reached, and subsequently by passing a ureteral sound down through the opening in the renal pelvis or the cortex. When there is no obstruction, the sound can generally be introduced readily until the brim of the pelvis is reached, but some manipulation may be required to make it pass this

point ; with a gum-elastic instrument there is usually no difficulty, but it is desirable to use a metal probe so as to recognise whether a given obstruction is inflammatory or due to a calculus.

A stone in the pelvis of the kidney can be removed by stone-forceps. Smaller calculi may be removed by a scoop, but very minute ones should be either flushed out or turned out with the finger. Branched calculi may cause much trouble, as their removal entire would involve extensive laceration of the renal substance, while, if broken up and removed piecemeal, fragments may be overlooked ; the latter procedure is, however, the better plan. The treatment of a calculus in the ureter is dealt with on p. 572.

After the stone has been removed, the procedure depends upon whether the kidney is the seat of suppuration or not. *When there is no pyelitis*, the wound in the kidney or the pelvis is closed completely ; this is also advantageous in that it not only avoids a renal fistula but arrests the hæmorrhage, but the latter point is not of great importance, as bleeding can be kept under control during the operation by compressing the pedicle of the kidney, and the oozing from the cut surface is generally trifling by the time the operation is concluded. Mattress sutures may be used to close the substance of the kidney as in the case of a laceration (see p. 533), and the capsule is subsequently stitched. A drainage tube is inserted through the incision in the lumbar wall down to the kidney, and the muscles are united by sutures. *When pyelitis is present*, the renal incision should be left open and a large drainage tube inserted into the pelvis, and a second one into the peri-renal area, and all the structures in the loin should be taken up by deep silkworm-gut sutures, no sutures being buried.

If the wound remains aseptic, the tube may be removed on the third day ; should leakage of urine take place, it should be retained until this has ceased. Should suppuration occur, drainage must be continued until suppuration has ceased, and then the tube is gradually shortened. When a drainage tube is employed, care must be taken to see that it passes well through the lumbar muscles, otherwise deep-seated suppuration may occur in the loin.

The after-progress of the case depends upon whether pyelitis is present or not. After the operation, there may be free hæmaturia, if the incision has been made through the kidney substance, and clots may pass along the ureter and give rise to renal colic, but the bleeding usually ceases after about forty-eight hours. When the stone has been removed through an incision in the pelvis of the kidney there is little or no hæmaturia. There is often severe shock and pain associated with the operation, and morphine should be given for its relief if the condition of the other kidney is satisfactory. At first the patient should be kept on a milk diet, but when the hæmaturia has ceased, he may have plain, non-stimulating food, with a large quantity of fluid. Enemata should

be given daily. The patient should be kept in bed as long as there is any suppuration, but when the wound has contracted to a small size and only emits urine, he may be allowed to go about wearing a suitable apparatus to catch it. Convalescence may last from a fortnight up to several months.

Nephrectomy.—The cases for which this operation may be required have been indicated on p. 565. The lumbar incision should be employed (see p. 565), as the ureter may have to be followed down for a considerable distance; if more room is required, it may be obtained by removing the last rib sub-periosteally. The abdominal route is not as a rule advisable in nephrectomy for a stone, as pus is practically always present in these cases; in the great majority of cases of renal stone, the organ can be removed perfectly easily through a lumbar incision, combined if necessary with the extension upwards described on p. 565.

The peri-nephric adhesions are usually numerous; in clearing the kidney it may be ruptured, and pus will escape into the wound. The pedicle is exposed, and the kidney is drawn out of the wound if possible; this must be done very cautiously lest the pedicle be shrunk and unable to bear traction (see p. 553). If the kidney cannot be brought out on the loin it must be cleared *in situ*, and when this has been effected the ureter should be sought for, isolated, and clamped. An aneurysm-needle, carrying a long stout silk ligature, is next insinuated through the middle of the pedicle as near the spine as possible, so as to leave sufficient length of pedicle on the renal side of the ligature, and divided into two. Each half of the ligature is tied separately and firmly, and finally one of them is carried round so as to enclose the whole pedicle, and its ends are left long so as to enable the pedicle to be examined for bleeding afterwards. A point of importance is to put the pedicle on the stretch while passing the aneurysm-needle, but to push the kidney back and relax the pedicle completely, as the ligature is tightened; unless this is done, the vessels may slip out of the ligature. After the vessels have been tied, they are divided close to the kidney, and then the latter is brought out on the loin and the ureter examined and dealt with according to circumstances. The first essential is to ascertain whether a stone is impacted in the ureter, and this can be done by making a puncture into it below a clamp placed upon its upper end and passing down a ureteral sound; it may generally be assumed that there is no obstruction if the ureter is not dilated below the kidney, and in that case it is ligatured about an inch below the pelvis, the kidney cut away, and the end of the ureter invaginated and sutured much in the way that a divided portion of intestine is treated. Finally, the pedicle is examined to make sure that all the vessels are secured; any oozing points are tied separately.

Furious hæmorrhage is occasionally met with in the course of nephrectomy. Sometimes it is due to too severe traction upon the pedicle,

which tears across the renal vein or even tears it away from the vena cava. Occasionally, it may be due to division of these structures by the knife or scissors, while sometimes the ligature on the pedicle may slip or may not be tight enough, and the wound at once fills with blood so that it is impossible to see its source. As the hæmorrhage comes from the pedicle or its neighbourhood, the hand should be thrust into the wound immediately in all cases, and the pedicle of the kidney seized firmly, whilst the fingers may also compress the aorta and vena cava. This allows the blood to be sponged away, when the bleeding vessels can be seen and secured. The most dangerous hæmorrhage, however, comes from a lateral slit in the vena cava, most commonly produced by detaching the renal vein from it. If the orifice is small, it may be seized in forceps and a lateral ligature applied. Should that fail to hold, the best plan is to have the vein compressed above and below by an assistant's fingers or some flat instrument, and then to suture the slit with a fine continuous catgut stitch. Failing this, the only thing is temporary plugging of the wound or leaving a pair of pressure-forceps on the vessel for forty-eight hours.

Opinions differ as to the best method of dealing with the divided end of the ureter. Unless there is reason to suspect sepsis in the wound, it is unnecessary to do anything to it. When suppuration is present and there is therefore every prospect of sepsis, this plan is unsatisfactory, as the ligature may give rise to a sinus, and it is therefore better to bring the end of the ureter into the lower angle of the wound and stitch it there with silkworm-gut, which can be removed in four days, by which time the ureter will have become adherent.

It may be impossible to tie off the pedicle in the manner described above, and then the best plan is to apply a temporary ligature close to the kidney and remove the latter, leaving a portion of renal tissue attached to the pedicle. It may then be possible to apply a second ligature sufficiently far back to allow this portion of the pelvis of the kidney to be removed; but if this cannot be done, the stump should be swabbed with undiluted carbolic acid and the ligature left long, with its ends hanging out of the wound, in case suppuration and separation of the ligature should occur. Should no suppuration occur, the ligature may be cut short, as deep down in the wound as possible, and the tissues allowed to close over it. This plan will obviate those troublesome sinuses, sometimes lasting for years, which so frequently follow the removal of a suppurating kidney when the ends of the ligature on the stump of the kidney are cut short.

Occasionally, the adhesions are so dense and the pedicle of the kidney is so short that it is impossible to free the organ sufficiently to remove it in the ordinary fashion, and a modified operation, sometimes called a *sub-capsular nephrectomy*, has to be performed. In order to do this, the proper capsule of the kidney is freely divided and the organ is

enucleated from within it ; while this is being done, the renal pedicle is compressed by an assistant, so as to check the bleeding. As much of the kidney as possible is shelled out piecemeal from the capsule, and finally the pedicle is tied up *en masse* and the kidney capsule cut away, after which it may be possible to isolate and tie the individual vessels. This form of operation should only be done when nothing else is possible, and is inadmissible if the kidney is tuberculous.

After the kidney has been removed, a large drainage tube is introduced through the posterior angle of the wound, the rest of which is brought together by interrupted silkworm-gut sutures, taking up the whole thickness of the lumbar wall ; buried sutures must not be used, as suppuration is likely to occur. The patient is put back to bed with the arm on the affected side bound to the trunk, and the knees flexed over a pillow and fastened together. There is generally a good deal of shock, with considerable pain and abdominal tenderness, and to meet this, subcutaneous saline infusions may be required ; there is no objection to giving injections of morphine if the other kidney is fairly healthy. The intense thirst so often complained of is best relieved by allowing the patient to suck ice or to take soda-water in small quantities by the mouth, and by continuous saline protoclysis (see Vol. I. p. 115). There will probably be free oozing, and the wound will require dressing frequently in the first forty-eight hours.

Treatment of renal colic.—The first indication is to alleviate the pain and spasm, and thus to facilitate the passage of the stone along the ureter. Injections of morphine and atropine should be given every three or four hours, if necessary, if there is only enough albumen present in the urine to be accounted for by the pyuria. A hot bath should be administered, and the patient left in it until he feels faint ; he should then be put back to bed. The shoulders and thighs should be raised so as to relax the abdominal muscles. If the pain is so severe that these methods do not allay it, inhalation of chloroform may be resorted to, but this is very rarely necessary. As a rule, the stone passes in a few hours, or goes back into the renal pelvis. Should it become impacted, it must be removed (see p. 571).

URETERAL CALCULUS.

The surgeon may be called upon to deal with a calculus impacted in the ureter under two different sets of circumstances. On the one hand he may find that in the course of an operation for renal stone the ureter is blocked by a second calculus, which of course will require removal either at the time of the operation—if the patient's condition allows it—or at a subsequent period when the effects of the kidney operation have been somewhat recovered from. When, on the other hand, the

ureteral calculus is the sole lesion, there is no necessity for cutting down upon the kidney.

The diagnosis of a calculus impacted in the ureter, as distinguished from a calculus in the kidney, is of great practical importance, as it is obviously of advantage not to do more in the way of operative interference than is absolutely necessary.

An important point in the diagnosis is that the escape of urine from the affected side is interfered with by the calculus impacted in the ureter, and it is easy to determine this fact by the aid of the cystoscope after injection of indigo-carmin (see p. 511). The coloured urine will be seen issuing from the sound ureter, while none comes from the affected one. This, however, does not tell the surgeon more than that the ureter on that side is occluded, and of course this may be due to a stone impacted in any part of its course. If the other kidney is healthy and there is no reflex anuria, dilatation of the ureter and pelvis of the kidney will occur above the obstruction, and there will be a tumour in the loin. Should the stone act as a sort of ball-valve at the commencement of the ureter, a condition of intermittent hydronephrosis will be established. When hydronephrosis is present, the blockage is incomplete; when the obstruction is sudden and complete, the kidney may undergo atrophy without hydronephrosis occurring. Most of these calculi are opaque to the X-rays, and can be diagnosed and localised with some certainty by means of a radiogram. Further, if a catheter which is opaque to the X-rays is passed up the affected ureter, it will be arrested at the seat of impaction and can be radiographed *in situ*.

Occasionally, especially in spare subjects, the calculus may be felt through the abdominal wall, the rectum, the vagina, or the bladder. When a stone is impacted in the lower end of the ureter, in the female, it is fairly easy to feel it *per vaginam*. When it is impacted in or near the ureteral orifice, the protrusion of the mucous membrane of the ureter may be recognised by the cystoscope. The most common seats of impaction are the points at which the diameter of the ureter is smallest—namely, about two inches from the hilum of the kidney and at the vesical end of the ureter; there is another narrow part where the ureter crosses the brim of the pelvis. The ureter above the obstruction becomes thickened and dilated, but it may undergo ulceration or sloughing later on, and when the impaction is in the wall of the bladder the stone may escape into that viscus by ulceration.

TREATMENT.—When it is certain that the stone will not pass down the ureter—and this can be ascertained by taking a series of radiograms at suitable intervals—it should be removed, if possible, by an extra-peritoneal operation. The exact steps of the operation will depend both upon the seat of impaction and also upon whether the stone in the ureter is the sole lesion.

When a stone is found in the ureter in the course of an operation for stone

in the kidney, it should be removed at the time, *if it lies above the brim of the pelvis*. To do so, means very little addition to the time occupied, and the ureter is more easily reached than if the wound were allowed to heal and an attempt made to remove it at a subsequent operation. A comparatively slight extension of the oblique lumbar incision will enable the surgeon to deal with this portion of the ureter satisfactorily. In the first place, an attempt may be made to press the stone upwards into the renal pelvis, and remove it through the opening made for the extraction of the renal calculus. Such attempts should, however, be made very gently so as not to bruise the ureter, and if it is found impossible to push up the stone into the pelvis of the kidney, an opening should be made into the ureter. This incision is made in the long axis and posterior wall of the ureter, just above the stone, and extends down to its upper margin: it should not be made over the stone, as that part of the ureter may be thinned and distended and the stitches might not hold afterwards. The incision in the ureter should be slightly longer than the stone. The calculus is then squeezed upwards and extracted through the opening, which is then closed by two or three interrupted sutures of fine catgut, taking up the outer coats only, care being taken not to invert the edges of the ureter too much lest stenosis should occur; to prevent this, some surgeons prefer not to insert any stitches in the ureter. As a matter of practice, it is found that when the peritoneum and the abdominal contents fall back into place, the incision in the ureter lies against the posterior wall of the abdomen, and little or no leakage occurs. In any case, a drainage tube should be introduced down to, but not in actual contact with, the ureter, so that any urine which may escape can pass out freely.

A probe should always be passed down through the opening in the ureter to see if a second stone is present. If one is found close to the other, it may be got out through the same opening; if not, its position is located and it may be removed subsequently through a separate incision, unless indeed calculous anuria is present, when it may be advisable to take it away at once (see p. 576).

The operation for removal of a stone from the ureter *below the brim of the pelvis* will vary according to its position, and may be considered under three headings: (a) When the stone lies in the portion of the ureter extending from the brim of the pelvis to about two inches from the bladder; (b) when it lies in the last two inches of the ureter outside the wall of the bladder; and (c) when it lies in the portion of the ureter situated in the wall of the bladder.

When the stone lies in the portion of the ureter extending from the brim of the pelvis to about two inches from the bladder, a separate incision should be made.

There are two routes by which the pelvic part of the ureter can be got at and a stone removed from its interior. The one most generally

used is very similar to that formerly employed for the extra-peritoneal ligature of the external or common iliac arteries and known as Abernethy's incision. In this operation, the incision commences just outside the internal abdominal ring, and runs upwards and outwards parallel to Poupart's ligament for about an inch and a half, and then turns upwards to end an inch or more above and internal to the anterior superior spine of the ilium. The three abdominal muscles are divided separately, the transversalis fascia is slit up throughout the length of the wound, and the peritoneum and its subjacent fat are stripped upwards and inwards towards the umbilicus. This exposes the external iliac and part of the common iliac arteries, and the ureter can be identified as it crosses the bifurcation of the latter. Care is required to avoid stripping up the ureter with the peritoneum. When the ureter has been identified, it can be traced upwards or downwards; it is then steadied by a loop of gauze introduced behind it, and the stone extracted in the manner described above (see p. 572).

Another method which is specially useful when the stone is low down in the pelvis is to expose the anterior surface of the bladder as for supra-pubic cystotomy, but through an incision more to the affected side than the ordinary central one. The bladder is exposed in the usual manner, and then the peritoneum is stripped backwards from the wall of the abdomen until the brim of the pelvis is reached, when the ureter is seen crossing the iliac vessels, and can be defined and traced upwards or downwards as desired. Either of these incisions will allow the ureter to be exposed from above the brim of the pelvis almost to its insertion in the bladder. In the female, the broad ligament interferes with free manipulation, and the uterine artery and vein will have to be divided between two ligatures.

When the calculus is impacted in the lower two or three inches, it may be got at in several ways. The last method described above will often prove quite satisfactory, but some surgeons prefer to make the incision in the middle line or only slightly to one side of it, as in supra-pubic cystotomy, and to open the peritoneum just above the top of the bladder sufficiently to admit the finger, so that the lower portions of the ureters may be palpated, and the position of the stone or stones ascertained; the opening in the peritoneum is then sewn up, and the operation proceeded with in the manner described above.

In the *Lancet* (1913, vol. i. p. 1578), Mr. Frank Kidd describes an operation by which this portion of the ureter may be reached by a lateral muscle-splitting operation. The incision is about three inches long, and is situated two fingers' breadth above and parallel to Poupart's ligament, one inch of the incision overlapping the rectus muscle and two inches being situated outside it. The various muscles are split in the direction of their fibres, which run nearly parallel in this situation, the rectus is pulled inwards and the transversalis fascia divided. The

vas deferens is pulled downwards and inwards, and the spermatic vessels upwards and outwards. The peritoneum is separated until the external iliac artery is exposed, and this is cleared upwards until the ureter is seen crossing it. The ureter is then raised for two or three inches, brought forward, and steadied on blunt hooks. Two stitches of fine catgut are inserted in the wall of the ureter parallel to each other, and a small incision is made into its lumen between them, a probe is passed down the ureter and the position of the stone ascertained. Special forceps are now substituted for the probe, and the stone seized and extracted partly by them and partly by manipulation. The incision in the ureter is closed by stitches, a small drain inserted for two or three days, the split fibres of the muscles united, and the wound closed.

This part of the ureter has also been reached by the sacral and the vaginal routes. The sacral route has now been abandoned and need not be described, but in some cases the vaginal route may be employed with advantage. A vertical incision is made in the anterior cul-de-sac of the vagina, the cervix uteri being dragged forcibly downwards and backwards with a tenaculum so as to make the vaginal roof tense. The bladder is then separated with the finger as far up as the vesico-uterine cul-de-sac, when the ureter containing the stone is exposed. A longitudinal incision is made for the removal of the stone, and, after extraction, it is usually unnecessary to suture the ureter; a few stitches in the vagina, leaving between them space for any leakage of urine, will be sufficient.

When the stone is impacted in the ureter, where it lies in the wall of the bladder, it may be removed through the bladder, and this operation may be combined, if necessary, with exposure of the ureter from outside, where it enters its wall. The central incision should be employed, and the anterior wall of the bladder is opened, and, if necessary, the peritoneum is separated from the bladder until the point of entrance of the ureter into its wall is reached. The stone can be steadied with the finger applied over this point and pushed towards the ureteral orifice. Bougies, or fine forceps, may be introduced into the ureteral orifice, which is gently dilated, and then, with one finger in the bladder and one in the wound, an attempt is made to squeeze the stone out into the bladder, or, at any rate, to protrude it sufficiently to allow it to be seized with forceps and extracted. Should this fail, the orifice of the ureter may be slit up with a probe-pointed bistoury, and a small scoop or curette used to get out the stone. The enlargement of the ureteral orifice must be done carefully, as it is important not to cut completely through the muscular wall of the bladder, and thus allow urine to percolate into the cellular tissue. The obliquity and dilatibility of the canal in the wall of the bladder will usually allow the stone to be extracted through a comparatively small incision.

In the female, the urethra is dilated, a Kelly's urethral speculum

(see Fig. 131) is inserted, and the stone projected forward from the vagina, so that the orifice of the ureter is rendered accessible. Here it is as a rule unnecessary to explore the ureter outside the bladder by an incision above the pubes.

SUPPRESSION OF URINE.

Among the complications associated with stone—especially after an operation—is suppression of urine, which may be either obstructive or non-obstructive. By obstructive suppression, or ‘calculous anuria,’ is meant blockage of the ureter or ureters by a stone, by the non-obstructive form, a condition in which suppression is brought about reflexly by the shock of an operation acting upon kidneys already diseased.

CALCULOUS ANURIA.

This is the most serious complication of renal calculus, and may occur independently of operation from blockage of the ureter by a calculus. Occasionally, calculi block both ureters, but when calculous anuria occurs it usually implies that the patient has only one functionally active kidney, and that a calculus has blocked its ureter. As a sequela of operation, it usually follows nephrectomy—a stone passing down the opposite ureter and blocking it; it is hardly likely to occur after nephrolithotomy, unless the kidney operated upon is badly diseased, because that kidney will go on secreting, provided there is free escape for urine either through the ureter or through the lumbar wound. When, however, little kidney substance is left, the blockage of the opposite ureter may lead reflexly to arrest of secretion in both kidneys. At first the condition is simply one of obstruction to the exit of the urine from the kidney, but very soon the secretion of urine ceases.

The *symptoms* differ in their mode of onset, and in their character, from those due to other forms of obstructive anuria—such as pressure on the ureter by a cancerous uterus. In most cases there is pain in the kidney on the affected side, but this usually subsides in a day or two. Occasionally, there is no pain, and no history of a previous attack of renal colic, and thus it may be difficult to determine on which side the blockage has occurred. There is usually a constant desire to pass water, and the anuria may be partial or complete; in the former case, the small quantity of urine passed is of low specific gravity, and does not avert a fatal termination. When anuria occurs after an operation, the general condition is comparatively good, the mind is unaffected, and the pulse and temperature may be normal. The patient may even be able to take food, there may be no vomiting or nausea, and the tongue may be clean, and is often moist; there is generally sleeplessness, but

no marked restlessness, and little or no delirium. Whether the condition follows an operation or not, it may be eight or ten days before symptoms of uræmia set in ; indeed, twenty-five days have elapsed after the onset of anuria before death took place. Death may occur without any characteristic symptoms of uræmic poisoning, but when they appear, death follows very rapidly.

The condition is very different from the non-obstructive form of anuria—the ordinary suppression of urine—and is readily diagnosed from it. There the headache, nausea, vomiting, slow pulse, dry tongue, early onset of uræmic convulsions, and the drowsy and semi-delirious condition of the patient sufficiently indicate what has happened.

The diagnosis of calculous anuria from other obstructive conditions may be made by the sudden onset, the pain in the kidney, a previous history of renal calculus, and the absence of any other obstructing cause—such as a tumour in the pelvis. X-ray examination will often show the presence of a stone.

TREATMENT.—Of obstructive anuria.—When calculous anuria occurs, the surgeon must either perform nephrotomy, so as to allow the urine to escape from the pelvis of the kidney, or remove the stone from the pelvis of the kidney or the ureter. Hence, the first point is to determine the side affected, and the second to ascertain the seat of the calculus. When nephrectomy has already been performed on one side, it only remains to ascertain where the impaction on the other side has taken place (see p. 571); when the position of the stone has been ascertained, it is removed in the manner already laid down (see p. 572).

Frequently, the patient is not in a condition to stand a prolonged operation, and then the only alternative is to perform lumbar nephrotomy and establish a temporary renal fistula. The sooner this is done the better, as otherwise the kidney may not secrete again, and the patient may die in spite of the operation. When the anuria does not follow nephrectomy, the nephrotomy should be done on the side last affected—that is to say, that on which there were symptoms of renal calculus last, for the kidney that has been longest affected may be entirely destroyed. When the patient has recovered from the anuria, the calculus should be removed. When the calculus is situated in the vesical end of the ureter, the stone may perhaps be removed at once, instead of performing nephrotomy ; but, when the patient is in a serious condition, the operation would probably increase the shock so much that the kidney would not secrete again in spite of removal of the stone.

Of non-obstructive anuria.—The treatment of this condition is essentially medical ; among the best measures is the hot-air bath. The bed-clothes are arranged over a long cradle, and tucked in everywhere, and hot air or steam is conducted beneath them by means

of a tube; the patient is left in this atmosphere for half an hour, when profuse sweating generally occurs. If hot air is used, the outer end of the tube terminates in a funnel inverted over a lamp, while if steam is employed, an ordinary bronchitis-kettle may be used. Hot air is preferable. The greatest care must be taken that no portion of the apparatus touches the patient. A substitute apparatus may be improvised by surrounding the patient with blankets, outside which hot-water bottles are packed; where the electric current is available, electric lights may be strung on a cradle and covered over with a blanket so as to form a radiant-heat bath. In all cases, signs of cardiac failure must be carefully watched for.

Still more certain is the hot wet-pack, in which a thick blanket is saturated with water almost at boiling-point, and then rapidly wrung out to remove excess of moisture. The patient is quickly and entirely swathed in this, with the exception of the head and face, and several blankets are wrapped outside it; the patient is left in the pack for a couple of hours, at the end of which time he generally sweats profusely. He is then rubbed dry and well covered up with hot, dry blankets. During the time he is in the pack, he should drink freely of hot barley water or other diluent drinks. The action of the wet-pack or of the hot-air bath may be increased by the administration of a subcutaneous injection of pilocarpine (gr. $\frac{1}{2}$ to $\frac{1}{4}$), but the effect of the latter must be carefully watched, as it may produce dangerous depression. Brandy and water should be given if the patient becomes collapsed. Dry cupping to the loin is valuable.

RENAL FISTULA.

Sinuses may be present in the loin, either after the bursting or opening of abscesses or after operations, and may be due to a variety of causes—such as spinal disease, disease of the appendix, gall-bladder, duodenum, or colon, or contusions of the loin which fail to heal either because there is imperfect drainage or because the original cause is still active. Hence, we are concerned with sinuses which occur in connection with the kidney. These may be divided into two large groups: non-urinary and urinary fistulæ.

NON-URINARY SINUSES.

Important causes of non-urinary sinuses are operations on the kidney, followed by suppuration and the extrusion of stitches, or those which occur in connection with the upper end of the ureter after nephrectomy. They may also result from disease of the kidney itself—such as a peri-nephric abscess due to stone or tubercle—in which, although no communication exists with the pelvis of the kidney, the

wound does not heal, on account of the original disease of the kidney which led to the formation of the abscess.

TREATMENT.—*When the persistence of the sinus is due to imperfect drainage* this must be rectified. When a peri-nephric abscess is not opened until it has lasted a long time, it may have burrowed extensively, and healing may be delayed by imperfect drainage of the outlying recesses, or the part of the sinus passing through the lumbar wall may become unduly narrow before the deeper parts have healed. The treatment for this is dilatation of the canal and maintenance of a free exit for discharge from the interior. The sinuses may be either gradually dilated or slit up; forcibly tearing open the sinus with forceps may lead to accidents—such as opening the peritoneum or even the colon. The best way is either to dilate them gradually with bougies or laminaria tents, or to enlarge them with a knife in the backward direction.

When the sinus is due to infected stitches or a septic ureter after nephrectomy, the proper treatment is to remove the offending stitches in the first case, and, in the second, to expose the ureter if possible, and dissect it out; short of that, scraping out the sinus and removing stitches is all that can be done.

When the sinus is due to renal disease, the question of an operation on the kidney will naturally arise; when stone is present, nephrolithotomy or nephrectomy will be required; when the kidney is tuberculous, nephrectomy is the only operation which will lead to the closure of the sinus.

URINARY FISTULÆ.

These are the more important cases, and may arise after operations, such as nephro-lithotomy or simple nephrotomy, or in connection with tuberculous kidney. These fistulæ naturally fall into two groups: namely, those in which the fistulous opening has been deliberately established for drainage of the pelvis of the kidney—for example, in pyelitis or calculous anuria—and those in which the fistula has followed an operation upon the renal pelvis or the kidney itself. The annoyance of a urinary lumbar fistula is so great that the patient will always beg to have something done to cure it, if possible.

TREATMENT.—When the fistula has been deliberately established, the treatment will depend on whether or not the cause which originally led to the operation still exists, and on the condition of the other kidney. For example, when it has been done for septic pyelitis, it is only a temporary expedient, and when the pyelitis has improved, the drainage tube should be left out, and the fistula will generally close of itself. The same will be the case if it has been established for calculous anuria and the ureteral stone has been subsequently removed. In both these cases, the opening into the pelvis of the kidney should be made through the kidney substance, so that a better surface for closure will be obtained than if it were made

through the thin wall of the pelvis itself. If, on the other hand, it has been done for a tuberculous and septic pyelitis, it will not close unless the tuberculous disease has been cured, and the only method of getting rid of the fistula is by nephrectomy ; indeed, in some of these cases, the drainage is only a temporary measure preparatory to a nephrectomy. When the fistula is due to an accidental wound of the pelvis of the kidney, and the organ itself is healthy and the ureter patent, it is probable that, if the sinus does not close after the establishment of efficient drainage, it may be cured by cutting down on the kidney, and stitching up the wound in the renal pelvis. When the fistula is due to disorganisation of the organ from suppuration or from tuberculous disease, nephrectomy is clearly indicated, if the condition of the opposite kidney permits.

Before determining on nephrectomy, it is of the highest importance to ascertain the condition of the opposite kidney, and also whether the urinary fistula is complete—that is to say, whether all the urine from the affected kidney passes through the loin. These questions are discussed in Chap. L.

CHAPTER LVI.

HYDRONEPHROSIS.

Two varieties of this condition may be met with: namely, persistent hydronephrosis and the intermittent form.

PERSISTENT HYDRONEPHROSIS.

Distension of the pelvis of the kidney may be due to various *causes*, chiefly such as produce obstruction to the escape of urine from the kidney. This must be incomplete at first, as sudden and complete obstruction to the flow of urine leads to atrophy of the kidney rather than to hydronephrosis.

The most common seat of the obstruction is in the ureter, and this may be congenital or acquired. Narrowing of the ureter may be congenital, but, as a rule, the typical chronic hydronephrosis is due to some obstruction which forms after birth. Any interference with the escape of the urine from the pelvis of the kidney may give rise to hydronephrosis, provided that the obstruction is not complete from the first. This may be due to blocking of the lumen of the ureter by calculi or tumours; to interference with the flow of the urine by kinks, twists, or valvular obstructions; to thickening of the wall of the ureter as the result of inflammation, which may be simple and lead to strictures, or tuberculous; to pressure on the ureter from outside—usually by tumours, such as a uterine cancer; or to causes situated lower down in the urinary tract—such as stricture of the urethra, enlarged prostate, or tumours in the bladder pressing on or involving the ureteral orifice.

The condition may be unilateral or bilateral. In the majority of cases it is unilateral, but in a certain number, and especially when it is caused by a tumour in the pelvis, it is bilateral, although it is then generally more advanced on one side than on the other. A small hydronephrosis is a comparatively common condition, but large hydronephrotic tumours are much rarer, for, unless there be some outlet for the urine,

atrophy of the kidney substance is apt to take place before any large swelling has formed. The affection is more common in women than in men.

The pelvis and calyces of the kidney become greatly dilated, and the cortex is compressed and atrophied. The kidney is frequently comparatively small, but occasionally it forms a large tumour, which may fill a large part of the abdomen, and then adhesions may occur between the capsule and the peritoneum or the intestine. The fluid in long-standing cases consists of water, with a little chloride of sodium, and an almost entire absence of albumen, uric acid, or urea.

The *symptoms* may extend over a number of years and vary much in intensity; in some cases, the condition may not give rise to any symptoms. When present, they consist mainly of pain in the back, frequent micturition, and a feeling of weight and dragging. When the affection is bilateral, nausea, sickness, a dry sallow skin, and some degree of uræmia may be present. The hydronephrotic tumour is irregular in outline and lobulated, situated in the flank, easily pressed backwards into the loin, and displacing the colon forwards.

The situation and shape of the tumour, the history, the presence of the colon in front and to its inner side, accompanied by dullness in the flank and loin, together with the fact that the patient at times passes too little urine, whilst at others there is an unduly large quantity—these periods, corresponding with the variation in size of the tumour—should enable a diagnosis to be made. Puncture of the swelling from the loin, and examination of its contents, will still further clear up the matter. This must be done with great care, otherwise the colon may be injured.

The best point for *puncture* is midway between the last rib and the crest of the ilium, about two and a half inches behind the level of the anterior superior spine. A needle passed horizontally in at this point would puncture the colon in a healthy subject, but hydronephrotic tumours, which are large enough to require tapping, will displace the colon sufficiently far forwards for it to escape damage. A moderately fine aspirating-needle is employed without an evacuating-bottle, as the fluid is thin, and the pressure within the cyst is sufficient to make it flow readily.

The prognosis depends on the cause of the distension, and on whether one or both kidneys are involved. In the latter case, the patient may gradually die of uræmic poisoning or from pressure on the neighbouring organs, or from rupture of the sac into the peritoneal cavity. In a few cases, the tumour has disappeared spontaneously.

TREATMENT.—The first point is to look for any condition in the lower urinary tract which may account for the affection, and if there is one, to remove it. Strictures of the urethra, enlarged prostate, or any bladder mischief, should be suitably treated if found. Pelvic tumours must be removed if possible; if not, the question of dividing the ureter

above the tumour and implanting it into the bladder higher up or into the bowel must be considered; if a stone is impacted in the ureter, it must be removed (see p. 571). In a certain number of cases, however, there is nothing wrong in the lower urinary tract, and the cause is in or close to the kidney. Under these circumstances, the surgeon has to make up his mind whether he will simply leave the case alone (possibly tapping the cyst from time to time) until it causes unbearable discomfort, or whether he will remove the kidney entirely, or endeavour by some form of plastic operation either to restore the continuity of the urinary canal or divert the urine into the bowel.

In arriving at a decision upon this point, it is often of the first importance to ascertain—by repeated attempts, if necessary—whether the obstruction is valvular or complete, and also where it is situated. It is also of importance to ascertain the functional value of the other kidney (see Chap. L.); occasionally, a hydronephrotic kidney has no fellow. Catheterisation with a ureteral catheter opaque to the X-rays, and the injection of collargol (see p. 513), may throw much valuable light upon these points. If the obstruction is valvular and at or close to the junction of the ureter with the renal pelvis, some form of plastic operation should be undertaken as soon as possible, while the distension of the pelvis is still slight and the renal tissue healthy. If the block is complete and situated fairly low

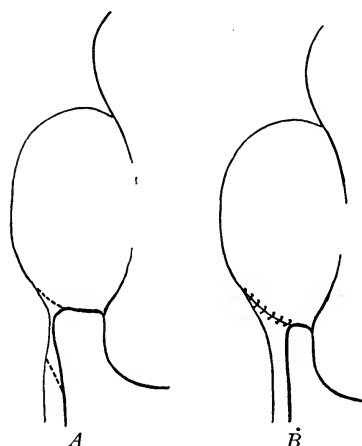


FIG. 149.—TREATMENT OF A STRICTURE OF THE URETER JUST BELOW THE RENAL PELVIS. The stricture is completely excised by two oblique incisions, as shown in *A*, and re-attached to the pelvis of the kidney so that there is a suitable opening, as seen in *B*. This is better than attempting a plastic operation for increasing the lumen of the ureter.

down the ureter, excision of the stricture and lateral anastomosis of the two ends of the ureter should be considered, and also the question of implanting the upper end of the ureter into the bowel.

When the hydronephrosis is large and causes much discomfort, or when the cause is irremovable and the functional activity of the other kidney is good, the best plan will be to remove the sac. It would only be advisable to do nothing—beyond possibly an occasional tapping—when the condition is known to have lasted a long time or to have reached a large size, and the patient is very averse to operation, or the kidney on the opposite side is defective. The operation of tapping is described in connection with the diagnosis of the affection.

Plastic operations upon the pelvis of the kidney.—The kidney should be exposed by an incision similar to that for nephro-lithotomy (see

p. 565), and brought out on to the loin in the usual manner, so that it can be examined both by sight and by touch. The subsequent procedure will vary according to the condition of affairs that is found.

When an abnormality is present in the upper part of the ureter or its attachment to the pelvis, it may be possible to produce a good result by a plastic operation, similar to that described below for intermittent hydronephrosis. If an annular stricture is found in the ureter below the pelvis, this may be treated by an operation similar to pyloroplasty (see Vol. IV. p. 288) ; this operation, however, is not always successful, and it may be better either to resect the affected portion of the ureter and perform a ureteral anastomosis (see p. 538) or to resect the stricture and attach the lower part of the ureter to the renal pelvis, according

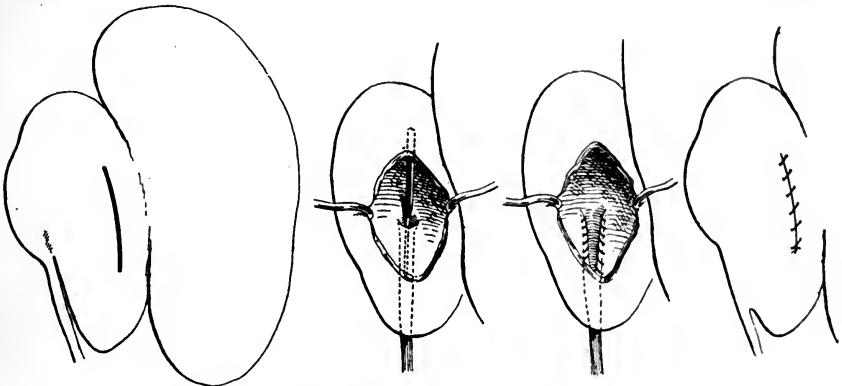


FIG. 150.—METHOD OF TREATING A VALVULAR CONNECTION BETWEEN THE URETER AND THE RENAL PELVIS. This is the operation described in the text, and is done through a separate incision in the renal pelvis, which is afterwards closed by suture. By its means a valvular opening is converted into one situated at a lower level on the wall of the renal pelvis, and the valve-action is done away with.

to the situation of the obstruction (see Fig. 149). In resecting the stricture, it is well to cut the ureter obliquely or, if transversely, to slit it down for a centimetre or so, and round off its angles so as to make a large opening. The union is made by a double row of stitches, the mucous membrane of the pelvis and the ureter being united by fine catgut, with a row of Lembert's sutures outside. A drainage tube should be introduced down to the neighbourhood of the new union, but not actually reaching it, and kept in for some days so as to provide against leakage of urine. Either of these operations is preferable to nephrectomy or the establishment of a urinary fistula.

When there is a valvular obstruction at the junction of the ureter with the pelvis, a useful method is to open the pelvis of the kidney, and after introducing a probe through the ureteral orifice, to divide the adjacent ureteral and pelvic wall in front of it for nearly an inch, taking care, however, not to go too low down, otherwise the cellular tissue outside will be opened up and there may be leakage of urine (see Fig. 150).

When the valve has been divided in this way, the mucous membrane of the pelvis and the ureter are closely united by fine interrupted absorbable catgut sutures, and it is well to put one or two Lembert sutures outside, at the lower angle of the incision, so as to make sure that no leakage occurs. The opening in the pelvis of the kidney is closed by Lembert's sutures, and it is always well to fix the kidney to the loin in the usual manner (see p. 521) so as to prevent subsequent kinking of the ureter.

If the cause of the hydronephrosis is an abnormal branch of the renal artery, the vessel should be divided between two ligatures and the effect upon the renal circulation noted. If a large portion of the kidney is thus deprived of its blood-supply, nephrectomy will be called for.

If these methods fail, nephrectomy will have to be considered. If the condition is unilateral, and if the patient insists on it, there is no objection to nephrectomy, provided the other kidney is healthy and active. The only alternatives are either to drain the hydronephrosis through the loin or to attempt to dilate the ureter with bougies; the latter method is very difficult and uncertain.

When there is an obstruction low down in the ureter this portion of the tube may be exposed (see p. 572) and an attempt made—by means of anastomosis after excision of the stricture—to restore its lumen, or the ureter may be divided above the stricture, its lower end closed, and its upper one implanted into the large intestine. When the obstruction is quite low down, the upper end of the divided ureter may be implanted into the fundus of the bladder. If these methods fail, nephrectomy will be necessary.

INTERMITTENT HYDRONEPHROSIS.

This is an important condition, in which there is intermittent dilatation of the pelvis and calyces of the kidney as the result of some temporary obstruction, which is relieved from time to time. The patient may have intervals during which he is quite well and the kidney appears normal, and then, apparently without any cause, there is violent pain in the loin, sometimes accompanied by vomiting and gradually increasing distress, and a distinct swelling can be made out in the renal region. This swelling is often tender, and may go on increasing for two or three days, when it may gradually or even suddenly disappear. Accompanying the formation of the swelling, there is a diminution in the amount of urine secreted, and there may be increased frequency of micturition and sometimes hæmaturia. When the distension passes off, especially if it does so suddenly, there is an increased flow of urine of low specific gravity; the intervals between the attacks vary. Patients suffering from this condition are usually the subjects of a movable kidney, sometimes to a very marked degree.

A stone in the renal pelvis may temporarily block the entrance to the ureter, and give rise to intermittent hydronephrosis, but the most frequent *cause* is some abnormal condition of the ureter itself. There may be a partial stricture or a temporary kinking of the upper part of the ureter in connection with movable kidney. The condition which we have most commonly met with is for the ureter to come off from the pelvis higher up than it should, so that a sort of valve is formed, and distension of the pelvis with urine is accompanied by pressure of one side of the ureter against the other, preventing the exit of the urine (see Fig. 151). This condition may be congenital, but it can also be acquired as a result of repeated kinking of the ureter due to movable kidney; in consequence, the pelvis becomes dilated, especially at the lower part, so that a sac is formed at a considerably lower level than the point of exit of the ureter, and the latter is apparently displaced abnormally high up on the side of the pelvis. It is not quite clear why in this condition the hydronephrosis should be intermittent, but it is possible that when the upper part of the pelvis becomes considerably distended, this opens up the valve, and so permits a certain amount of urine to escape. The injection of collargol into the renal pelvis by means of a ureteral catheter (see Chap. L.) will enable the

surgeon to detect on a radiogram the early stages of this affection, and he may thereby be enabled to interfere with complete success in these cases before any marked changes have taken place in the renal pelvis or kidney.

This condition is of course deleterious to the kidney, and may ultimately lead to persistent hydronephrosis. The patient usually suffers so much from these recurrent attacks that he is ready to have anything done that will afford relief.

TREATMENT.—During an attack, the patient should be kept at rest in bed, morphine should be administered, and hot fomentations applied. When the attack has passed off—as it usually does in a few days—the question as to the best method of curing the condition must be considered, and this can only be done by operation.

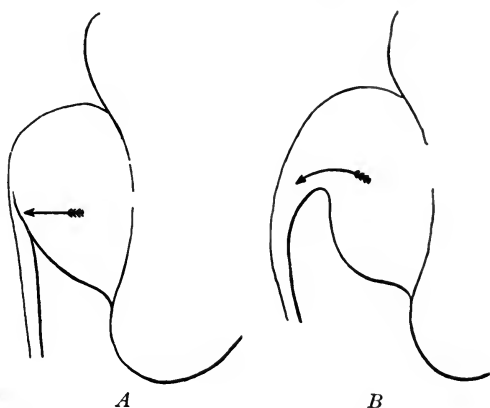


FIG. 151.—DIAGRAM SHOWING HOW A FAULTY ATTACHMENT OF THE URETER MAY CAUSE INTERMITTENT HYDRONEPHROSIS. A shows how the lower part of the pelvis may become dilated as a result of the unduly high attachment of the ureter. This produces a valve-like pressure of one side of the ureter against the other, and still further distension of the pelvis. When this has reached a certain point, the valve is opened by the great dilatation, and the urine in part escapes (B).

The operative treatment will vary according to the pathological conditions found when the kidney and ureter are exposed. The disease may, for example, be due to a partial stricture of the ureter at the upper part, in which case a plastic operation on the ureter will be necessary (*vide infra*). The most common condition is, however, intermittent kinking of the ureter in connection with a movable kidney, leading to alteration in the relation of the opening of the ureter to the renal pelvic cavity (*vide supra*). In the early stage, fixation of the kidney high up in the loin may prevent recurrence of the trouble, but if it has existed for some time, the renal pelvis will have become dilated, and this

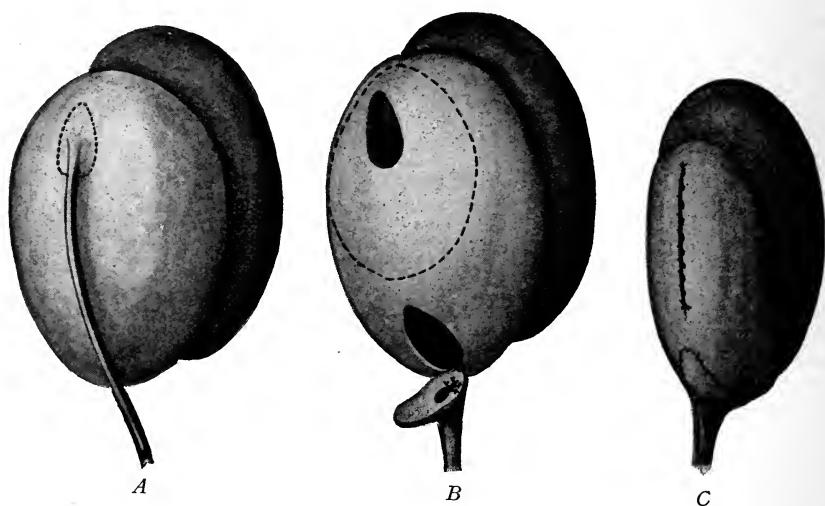


FIG. 152.—PLASTIC OPERATION FOR INTERMITTENT HYDRONEPHROSIS. A, shows the incision for detachment of the ureter; B, its re-attachment to the renal pelvis lower down, the dotted ellipse being the incision for the removal of the redundant portion of the pelvis; and C the operation completed.

operation alone will not succeed, and must be combined with one or other of the following procedures.¹

In the earlier cases, after finding that nephropexy was useless, except in a small number of cases, owing to the valvular condition of the ureteral opening in advanced cases, attention was turned to the upper end of the ureter and its relation to the pelvis of the kidney, and attempts were made to do away with the valvular character of the opening. This was done in the manner described on p. 585; in several cases much improvement followed, but the result was by no means perfect.

The following operation was ultimately evolved, and has answered admirably. The kidney is brought out on the loin through the usual

¹ See Intermittent Hydronephrosis, by W. Watson Cheyne, *Lancet*, 1907, vol. ii. p. 11.

lumbar incision, an incision made in its pelvis around the attachment of the ureter, and an oval piece containing the ureteral orifice detached; at the lower part, the incision runs about a quarter of an inch beyond the point where the ureter leaves the pelvis, at the sides the distance about half an inch, and at the upper part it is rather more. When this piece is detached, the orifice of the ureter is enlarged if necessary in the manner described above (see Fig. 152, *A*). A piece of the dilated pelvis at the lower end, corresponding in size and shape to the detached portion, is now cut away, and this flap is attached to the opening thus formed (Fig. 152, *B*) by a double series of Lembert's sutures. If deemed advisable, a portion of the dilated pelvis at the upper part may now be cut away and the opening closed by Lembert's sutures; in doing this, it is well to avoid making any connection between this incision and that for the attachment of the ureter, otherwise leakage may occur at the line of junction. The final result is shown in Fig. 152, *C*. The kidney is finally fixed high up in the loin in the usual manner, and the wound is sewn up by through-and-through stitches—a drainage tube being left in for a few days.

CHAPTER LVII.

NEW GROWTHS OF THE KIDNEY AND ITS PELVIS: HYPERNEPHROMA: CYSTS: PERI- AND PARA-NEPHRIC TUMOURS.

NEW GROWTHS OF THE KIDNEY.

BENIGN tumours, such as myxomata or dermoids, are very rare, and are hardly ever diagnosed until the kidney has been exposed. The great majority of the new growths of the kidney are malignant, sarcoma being more frequent than carcinoma. Carcinoma usually occurs in elderly people, and is accompanied by more profuse hæmaturia, pain, and cachexia than sarcoma.

The *symptoms* are often very obscure, the chief being hæmorrhage, pain, and the presence of a tumour. Hæmaturia may be one of the earliest symptoms of malignant disease of the kidney, and is often the first that attracts the patient's attention. It occurs spontaneously, is not affected by exertion, is commonly profuse, and may last for some days, ceases and reappears after a short time, and its occurrence is often ushered in by pain. The blood is intimately mixed with the urine, but is apt to clot, and the clots may give rise to renal colic. There may, however, be no hæmaturia if the growth does not encroach upon the renal pelvis.

In many cases, especially in children, the first thing that is discovered is a tumour, especially when the growth is situated in the lower part of the kidney or when the latter is movable. As a rule, it is painless at first, but, as it enlarges, dull, aching pain may set in, referred to the spine or to some of the spinal nerves and closely resembling that due to spinal caries. It has been suggested that the development of a varicocele may be a diagnostic point. The urine is not altered in the early stages; later on, the urea may be markedly diminished in amount, and pieces of malignant tissue may be found in the urine along with blood and clot. Cachexia and wasting soon become manifest. The growth spreads along the pedicle of the kidney, so that the mass may become adherent to

the vena cava ; it may also spread through the capsule and become adherent to the tissues around.

The *diagnosis* of renal tumours is often very difficult, and they have been mistaken even by the most experienced surgeons for tumours of a very different nature—such as retro-nephric sarcomata, enlargements of the liver or the spleen, tumours of the supra-renal body, ovarian tumours, enlargements of the lymphatic glands, fæcal accumulations, appendicitic thickenings, malignant tumours of the large intestine, the mesentery, or the omentum, or enlargements of the gall-bladder. The main diagnostic point is that the large intestine is in front of the tumour, which is dull on percussion right back to the spine, and that there is no space behind a renal tumour into which the fingers can be pushed. The enlargement of the kidney, moreover, may be due not to a tumour, but to some other condition—such as stone, tuberculosis, polycystic disease, hydatid cyst, or hydronephrosis. All these points must be inquired into when making the diagnosis.

TREATMENT.—When a malignant growth of the kidney is suspected, an *exploratory incision* is justifiable, because malignant disease spreads rapidly, and the chance of successful extirpation soon disappears ; if the enlargement turns out to be due to calculus, movable kidney, or tuberculosis, the discovery of the nature of the case is the best thing for the patient, while if it is due to early malignant disease the earlier it is diagnosed and removed the better. In these cases, either the lumbar or the anterior incision (see p. 590) may be employed. If it is necessary to incise the kidney in order to complete the diagnosis, the organ must be brought out on to the loin before this is done and carefully packed off with gauze. It is essential that no soiling of the wound with material from the kidney should occur, for to cut into malignant disease and allow the cells and juices of the growth to spread over the wound would almost certainly cause dissemination of the disease ; moreover, should there be pus in the kidney it is important to avoid infection of the wound. If the kidney is found to be the seat of malignant disease, the wound in it must be closely stitched up, and fresh instruments and gloves obtained, before proceeding to nephrectomy.

The treatment in these cases must be total extirpation of the kidney, and this should be done when the organ is comparatively small and movable. When, however, there is advanced cachexia, and swelling of the lower extremities from pressure on the vena cava, or when the tumour is rapidly growing, as is often the case in young children, it is not worth while performing nephrectomy, because all chance of removing the disease successfully has disappeared.

Nephrectomy.—The lumbar operation is not suitable unless the tumour is small, because it gives insufficient room ; when the kidney is large, it is better to use a trans-peritoneal operation through the linea semilunaris or even through the linea alba. This not only allows of

more easy removal of the kidney, but also enables the surgeon to ascertain the presence or absence of enlarged glands or metastases.

Trans-peritoneal abdominal nephrectomy.—The patient lies flat upon the back, and an incision about five inches in length is made, with its centre opposite the umbilicus, just internal to the linea semilunaris, on the affected side ; this incision can be enlarged upwards and downwards, as may be necessary. The anterior layer of the rectus sheath is incised in the line of the incision, the outer edge of the rectus pulled inwards towards the middle line, the posterior layer of the rectus sheath and the peritoneum opened throughout the whole length of the incision, and the intestines carefully packed over to the opposite side ; in this way the condition of the pedicle of the kidney and the glands in the neighbourhood may be ascertained before the operation is proceeded with. If it is found that the pedicle is not encroached upon by the growth and that the glands are unaffected, the colon is drawn inwards towards the middle line and the peritoneum outside it divided about an inch external to the bowel over the whole length of the kidney ; the peritoneum is then raised and pushed forwards, carrying with it the colon, until the pedicle is reached. The two edges of peritoneum may now be sewn together and the remainder of the operation performed extra-peritoneally. The surgeon isolates the pedicle and ties and divides the ureter in two places, securing the pedicle subsequently in the manner described on p. 568. The kidney can now be rapidly shelled out of its bed and removed. The surface of the pedicle is examined to see if the vessels have been properly controlled ; all bleeding is arrested and the abdominal wall is sutured in layers.

Some surgeons prefer an entirely *extra-peritoneal anterior operation* making a curved incision with the convexity outwards beginning at the tip of the eleventh rib and ending near the anterior part of the crest of the ilium, the peritoneum and colon being turned forwards without opening the former. The advantage of this incision is that the kidney is reached directly, and there is not the difficulty in retracting the muscles that there often is in the other operation. Its disadvantages are, however, that the state of the pedicle of the kidney cannot be ascertained in the early stage, and after considerable dissection it may ultimately be found that the case is inoperable ; further, greater damage is done to the abdominal parietes than by the transperitoneal method described above.

The prognosis of nephrectomy in these cases depends, firstly, on whether the tumour is primary or secondary ; secondly, on the period at which the disease is operated on ; thirdly, on the avoidance of infection of the cellular tissue with malignant disease during the operation ; and, fourthly, on the absence of glands or extension of the disease beyond the true kidney substance. Success may be looked for in favourable cases of primary disease if they are operated on early.

Embryoma and Hypernephroma are tumours which, apparently, arise in connection with embryonic rests—the former from germinal epithelium, and the latter from rests of the cortical portion of the adrenal glands. They are not uncommon, occur towards the upper pole of the kidney, and are indistinguishable from other malignant tumours. They form independent tumours in the kidney which push aside the renal substance and often attain a large size in a short time. After a time they penetrate into the renal pelvis, and then give rise to hæmaturia and anæmia. In children they may attain a large size, and may have reached an inoperable condition before they attract notice. The only treatment is nephrectomy.

NEW GROWTHS OF THE RENAL PELVIS.

Papilloma of the renal pelvis is sometimes found on incising the kidney for persistent hæmorrhage. The tumour may be a simple papilloma, or it may be developed on a malignant base. Even if it is simple, recurrence is apt to occur, and papillomatous masses may spring up along the ureter or in the bladder. If there is any suspicion of malignant disease, the proper treatment is either to excise the base of the tumour freely—if there is sufficient room to do so—suturing the renal pelvis subsequently, or, if this is impossible, to perform nephrectomy. If, however, the growth is obviously benign, it may suffice in the first instance to remove the tumour freely without taking away the surrounding tissues; should the symptoms recur, nephrectomy will be called for. It is fairly common for *malignant tumours* to begin in the renal pelvis, and the treatment is similar to that described above for malignant disease of the kidney itself.

CYSTS OF THE KIDNEY.

The principal cysts found in the kidney are simple serous cysts, hydatid cysts, cystic degeneration of the kidney, and polycystic disease. Dermoids have been met with, but are extremely rare.

SEROUS CYSTS.

This condition is not a localised dilatation of one of the calyces of the kidney, such as is the case in hydronephrosis, but is an independent cyst in the renal substance originating as a retention cyst in a tubule or in the Malpighian capsules. The cysts are usually single, may reach a large size, and may be situated anywhere in the organ; their contents vary much in character, the fluid being, however, generally clear and straw-coloured, and containing a little albumen and salts with no urea,

or only a trace. They usually give rise to no symptoms until a definite tumour has formed, when they are easily detected, but may be mistaken for a hydronephrosis.

TREATMENT.—Puncture has been recommended, but it is almost certain that the cyst will re-fill, and the proper line of treatment is either to excise the cyst or to incise and drain it. If the cyst is small and single, the simplest plan is to excise it, along with a thin layer of the renal parenchyma, through a lumbar incision. The bleeding is easily stopped by deep sutures passed through the renal tissue (see p. 533). When the cyst is very large, it may be better to lay it open and stitch the cut edges to the skin, after sponging the surface of the cyst wall over with undiluted carbolic acid. Healing will take place after a time, but this method is inferior to excision when that is possible. Primary nephrectomy is not called for, but it may occasionally happen that a permanent urinary fistula is established in the loin, and for the cure of this the patient may insist on a secondary nephrectomy.

HYDATID CYSTS.

These cysts are comparatively rare, and follow the same course as hydatids elsewhere. The affection is usually not noticed until a tumour of considerable size has formed, unless the cyst bursts into the renal pelvis, when there will be attacks of renal colic and the passage of small 'daughter-cysts.' The diagnosis is often extremely difficult. If the cyst has burst into the renal pelvis, 'daughter-cysts' will be passed; if the tumour is punctured after being exposed, examination of the fluid will reveal its nature.

TREATMENT.—This consists in stitching the cyst wall to the skin, drawing off as much of the fluid contents with a trochar and canula as possible, and then laying the cyst freely open, washing out the cavity, and removing the endocyst; a drainage tube is inserted. In some cases, however, the kidney is so completely destroyed that nephrectomy is the only possible treatment.

CYSTIC DEGENERATION OF THE KIDNEY.

This rare disease is also known as 'polycystic disease of the kidney,' and is seldom amenable to surgical treatment. It is bilateral in the great majority of cases, although the condition is usually more marked on one side than on the other. The liver and the spleen may also be similarly affected. The cysts are very numerous, and as the disease progresses, symptoms of degeneration of the kidney set in and the patient usually dies of uræmia. It has been suggested that the kidney in which the disease is most advanced should be removed, but this—at any rate, in some cases—has apparently been followed by a rapid

increase in the degeneration on the other side. If the disease is certainly unilateral, the affected kidney may be excised. The disease is often only discovered during life after an exploratory operation, and then the only question that arises is the advisability of opening some of the cysts so as to cause diminution of the tumour; in some cases this may give temporary relief.

PERI-NEPHRIC CYSTS.

These are extremely rare and are usually only diagnosed after operation. They may result from hæmorrhage outside the kidney.

PERI- AND PARA-NEPHRIC TUMOURS.

Tumours of the *supra-renal capsule* are not very uncommon, and are generally malignant adenomata presenting the characters of supra-renal tissue. It is often impossible to diagnose them from primary tumours of the kidney, although a suspicion of their true nature may be raised by rapid loss of flesh, bronzing of the skin, marked gastro-intestinal symptoms, pain referred to the tip of the shoulder, rapidity of growth, the position of the swelling, and the absence of hæmaturia.

TREATMENT.—This is similar to that for malignant disease of the kidney. In most cases the kidney must be excised as well as the tumour, because when the growth is of any size it will almost certainly have affected the kidney, and recurrence will take place speedily if the latter is left behind. In some rare cases, a partial nephrectomy—*i.e.* excision of the upper part of the organ with the adherent supra-renal capsule—may suffice. This point can only be determined during the operation.

Many varieties of *peri-nephric tumours* may be met with in the cellular tissue around the kidney, of which fibroma, lipoma, and sarcoma are the most common. These tumours are not necessarily always peri-renal in origin, as sarcomata may grow from the kidney capsule, and probably do so in the majority of instances.

The diagnosis is very difficult, and the case will generally be considered to be one of renal tumour; the absence of hæmaturia is an important although not a pathognomonic sign. The exact diagnosis is only made by a lumbar or a lateral abdominal incision.

TREATMENT.—This will depend upon whether the kidney is invaded or not. If the tumour is benign, it should be shelled out. In the case of a sarcomatous tumour, excision of the kidney as well may be necessary, especially if it is adherent to the growth. If there is only slight adhesion to one part of the kidney, the portion of the organ involved may be excised along with the tumour.

APPENDIX.

OPERATIONS ON THE FEMALE GENITAL ORGANS WHICH MAY BE FOUND NECESSARY IN THE COURSE OF AN ORDINARY LAPAROTOMY.

It frequently happens that a surgeon has to perform laparotomy when the exact diagnosis has not been made, or when more is found than was expected; in women, some affection of the genital organs may be found in addition to the other troubles, and this ought to be dealt with at once. For example, an operation for an acute abdominal condition may be undertaken, and, when the peritoneal cavity has been opened, the source of the trouble may be found in the Fallopian tubes. Again, in operating for chronic appendicitis, it is not uncommon to find that there is coexisting trouble in the ovary or tube, and that it is necessary to remove these structures. Surgeons may also have to deal with a ruptured ectopic gestation or ovarian cyst, and, in the course of other operations, fibroids of the uterus may be found, which ought to be dealt with at the same time. We shall therefore describe in this chapter the essential points in the operative treatment of those diseases peculiar to women which are most often met with in abdominal work and must be dealt with at the same operation.

The preliminary treatment of the patient, the preparations for a laparotomy, and the method of opening and closing the abdomen, have been fully described in Vol. IV. pp. 208-226. The remarks made there are applicable to these operations, but certain special points must be noted. When trouble in the female pelvis is suspected, the incision should be made to one side of the median line, so as to open the sheath of the rectus muscle, which is then split in the direction of its fibres. The incision is made below the umbilicus, and can be enlarged upwards to any desired extent. In dividing the peritoneum, at the lower end of the incision, care must be taken that the bladder is not damaged; it should always have been emptied just before the operation, and, as it may be displaced considerably upwards, it is always advisable to open

the peritoneum at the upper end of the incision and continue the division from above downwards. In all those cases of 'acute abdomen' in women, in which the pelvic viscera are suspected to be the cause of the symptoms, the vertical incision through the rectus should be utilised. If the abdomen has been opened elsewhere—for example, in the appendix region—and it is found to be impossible to deal with the condition from the lateral incision, a fresh one should be made just to one side of the median line. When, however, the original incision has been made through the outer edge of the rectus, it is often possible in thin patients with lax abdominal walls to retract the inner side of the incision sufficiently to get satisfactory access to the pelvis; the right tube and ovary, at any rate, can be readily dealt with.

Another important point is the employment of the Trendelenburg position. This position greatly facilitates the proceedings in most operations at the lower part of the abdomen, such as the removal of fibroids of the uterus or deep-seated broad ligament cysts, or the detachment of adhesions, especially to the rectum. It is not absolutely necessary to employ it when removing ovarian cysts, unless they are adherent to the pelvic floor, and we are of opinion that it should not be used in acute inflammatory conditions, when there is free fluid or pus in the general peritoneal cavity, or, at any rate, not until all such fluid has been carefully removed and the rest of the abdominal cavity packed off, otherwise there is great danger of spreading the infection to parts not yet affected. In any case, the Trendelenburg position should not be maintained for a longer time than is absolutely necessary, and the horizontal position should be resumed before the muscles are sutured; it is easier to bring the muscles together when the patient is horizontal.

The separation of adhesions demands great care. They may be thin and membranous or dense and firm, and they should be separated and divided as close to the parts to be removed as possible. Some of the adhesions may have to be divided between ligatures, so as to avoid hæmorrhage, but often a raw area will be left, from which persistent oozing takes place. If the Trendelenburg position has been employed, this oozing diminishes or entirely ceases, in many cases, when the patient is placed horizontal. Sometimes the bowel is so closely adherent to the tumour that detachment is impossible without seriously damaging it. Under these circumstances it is better to leave the adherent portion attached to the bowel and cut through the peritoneum around the point of attachment. Occasionally, resection of the intestine may be necessary. When raw areas are left after the separation of the adhesions, care should be taken to arrest the bleeding as completely as possible, and to cover them over by adjacent portions of peritoneum, if any are available. To prevent the re-formation of adhesions, the methods recommended in Vol. IV. pp. 294 and 360 may be used.

Injury to the intestine is a most serious complication, and is generally

fatal if it is not detected before the abdomen is closed. When firm adhesions have been separated, a careful search should therefore always be made for such injury before closing the wounds, and, if it has occurred, the damage should be repaired in the manner described in Vol. IV. pp. 320 *et seq.* The rectum is, perhaps, the part most often injured, and also the most difficult to repair; during the repair, the patient should be placed in the Trendelenburg position. Long-handled needles with different curves are very useful, and a double layer of sutures should be inserted, the outer layer passing through the sero-muscular coats only. If it is impossible to close the rent, the opening should be carefully packed round with gauze, which is brought out of the abdominal wound, and a drainage tube inserted just down to the tear, inside the gauze packing. The gauze may be removed by degrees after the lapse of four or five days, and the tube is gradually shortened. For a time, a fæcal fistula will persist, but it generally closes in the course of a few weeks. After an injury to the rectum, it is of course impossible to give enemata or salines *per rectum*—at least for a time. Many of these cases of injury to the bowel are due to the fact that the surgeon tries to separate firm and closely attached adhesions, and operates in a hurry.

Drainage is required in some cases. When there is persistent oozing, or when pus or turbid serous fluid are present, it is advisable to leave in a tube. In the former case, the tube may be removed at the end of twenty-four to forty-eight hours; in the latter, the time when the tube should be removed is determined by the amount and character of the discharge. A thick-walled india-rubber tube, half an inch to one inch in diameter, is the best. We are not in favour of using gauze as a drain; but in some cases the tube may be split vertically and a strip of gauze placed inside it, which may be pulled out in a day or two without disturbing the tube.

REMOVAL OF THE OVARY.

The operation of ovariectomy may be one of the simplest or, when there are numerous adhesions, one of the most difficult in surgery. The cyst is readily recognised by its bluish-white colour; if it is large, the peritoneum should be cautiously opened at the upper part of the incision, in the first instance, and as soon as the cyst is exposed, the hand should be passed all round it in order to ascertain if any adhesions are present. The cyst may be adherent to the omentum, bowel, appendix, or bladder. These adhesions should not be separated in the dark, but the wound should be fully retracted and the cyst pulled out, so that the surgeon can see what he is doing. In the great majority of cases, the cyst should be removed without evacuating its contents, and this can be done by enlarging the incision as much as may be requisite, and by retracting the edges of the incision over the tumour as it is delivered into the

wound. Adhesions should be looked for during this process and dealt with; omental adhesions are ligatured and intestine peeled off, and this can be more readily done if the cyst is tense. Another advantage of not tapping the cyst is that soiling of the peritoneum is prevented. The cyst may contain purulent fluid, or it may be a dermoid, or may contain papillomatous growths, or it may be malignant, and, by keeping the cyst entire, infection of the peritoneum due to the escape of the fluid is avoided; if the cyst is very large or adherent deep in the pelvis, it may, however, be necessary to evacuate it, in whole or in part, before it can be delivered out of the abdomen. The pedicle and the Fallopian tube are ligatured. The pedicle may be long and thin, or it may be broad and short, or twisted. If it is long and thin, it is transfixed by a pedicle needle passed through the broad ligament where there are no visible vessels. Sterilised silk is the most convenient material to use, and a long piece is threaded in the needle with the two ends of equal length. As the needle is withdrawn, the loop of the silk is caught and then divided so as to form two separate ligatures, which are tied separately round each half of the pedicle; finally one loop is tied round the whole stump. Before tying the ligatures, they may be interlocked. After the silk has been tied, the tumour is removed by dividing the pedicle some distance beyond the ligatures, forceps being applied below the ligature to hold up the pedicle so that it may be inspected to see that all the vessels are properly secured. If any vessels bleed, they must be ligatured or the whole pedicle again transfixed and tied. When the pedicle is thick and broad, several ligatures will be required. After the surgeon has made certain that there is no bleeding, the peritoneum is stitched over the raw surface and the pedicle allowed to drop back into the pelvis. Any blood is then mopped up from the peritoneal cavity, and the opposite ovary and tube are examined to see if they are healthy. No drainage is required. Dermoid cysts should always be removed entire, and the same remark applies to inflamed ovarian cysts and to those in which the pedicle is twisted. When the cyst has ruptured spontaneously, the peritoneal cavity must be thoroughly cleansed. If there are papillomatous masses in the peritoneum, and these are not malignant, they should be removed as completely as possible, care being taken not to injure the intestine.

REMOVAL OF BROAD LIGAMENT CYSTS.

These cysts are situated between the two serous layers forming the broad ligament, and are therefore covered by the peritoneum of that structure. After the intestine has been packed off with gauze and the patient placed in the Trendelenburg position, the peritoneum over the cyst is incised until the cyst wall is reached; it may then be shelled out. The ureter is often close to the cyst, and therefore care must be

taken that it is not injured. Any large vessel which bleeds must be ligatured, and there is not infrequently a good deal of oozing, which may be arrested by packing the cavity temporarily with gauze. After the bleeding has ceased, the gauze is removed, and the layers of peritoneum are sutured so as to close the cavity completely. If oozing is still going on, drainage is provided by placing a tube in the cavity, and the walls of the latter are stitched to the parietal peritoneum at the lower end of the incision before closing the wound.

REMOVAL OF THE TUBES AND OVARIES.

These operations are undertaken for a number of conditions. It is not uncommon to find a pyosalpinx without any pus outside the tubes; this condition is usually bilateral, and both tubes must be taken away; not uncommonly, the symptoms are those of 'acute abdomen,' and are found to be due to an acute inflammation of the tubes and ovaries, or to a pyosalpinx, which had been undiagnosed, and has ruptured and set up an acute peritonitis. The surgeon may also be called upon to operate for a ruptured tubal gestation, and, in operations for tuberculous peritonitis, the tubes and ovaries may have to be removed. Primary cancer of the Fallopian tubes may also be met with. Whenever possible, one ovary at least should be preserved, or as much of it as possible. In some cases it is possible to remove the tubes and leave the ovaries.

The chief difficulty in these operations arises from the presence of septic material in cases of acute ovaritis and salpingitis, and from the presence of adhesions. The parts should be exposed by means of a free incision in the parietes, and the intestines carefully packed away by pads into the upper part of the abdomen before any adhesions are separated. A careful inspection of the state of affairs is then made, and a point selected at which to begin the detachment of the tube and ovary. By means of the fingers and the cautious use of a blunt dissector, the distended tube is gradually separated from the broad ligament, uterus, and rectum, and the floor of the pelvis. Especial care should be taken not to injure the rectum, or to rupture the tube. If the latter accident should happen, the pus must be quickly mopped up as it escapes; any injury to the rectum is repaired later in the operation. There will be a good deal of oozing during the removal of the inflamed parts, and, in order to see what is being done, the operation area must be kept as dry as possible. The oozing soon ceases after the separation of the tube and ovary, and, when these have been brought out of the wound, the pelvic cavity may be temporarily packed with a long and broad piece of gauze. The pedicle is clamped, and an absorbable ligature of fairly stout catgut is tied around it. It may be necessary to use one or two ligatures, and to secure the pedicle by transfixing it. Any vessels

which escape this ligature must be separately tied. The tube should be removed close up to its uterine end, and it is often possible to bury the stump after disinfecting it with pure carbolic acid, or cover it with an adjacent portion of peritoneum. If the ovary is healthy it should not be removed. It is generally advisable in these cases to put a drainage tube down to the bottom of the pelvis for forty-eight hours or longer, according to the amount of discharge.

The operation for removal of a tuberculous or cancerous Fallopian tube is conducted on similar lines, but in these cases it is not necessary to insert a drain.

OPERATION FOR EXTRA-UTERINE FŒTATION.

When the operation is done before rupture has occurred, it is conducted on lines similar to those for the removal of an inflamed tube. More frequently, the surgeon is called upon to deal with the condition when rupture has taken place, and the patient is in a serious condition from loss of blood. Under these circumstances, all the precautions to mitigate the shock must be taken (see Vol. I. p. 118). The abdomen is rapidly opened below the umbilicus, and the presence of the blood is generally demonstrated by the dark colour seen through the peritoneum. The liquid blood is allowed to escape, and any clots are quickly removed by the hand, which is passed into the pelvic cavity, and the tubes and ovaries examined. The one found to be enlarged is compressed, freed, brought up to the surface, and a clamp placed on the uterine side of the rupture, a second clamp being also placed if necessary on the outer end of the broad ligament, so as to control the hæmorrhage temporarily. The broad ligament is then transfixed by a pedicle needle carrying a silk thread, the loop of which is divided, so as to form two ligatures, which are tied so as to secure the vessels in the broad ligament. The Fallopian tube is then removed; and the stump seized in a pair of forceps, which are left on temporarily. The bleeding is thus controlled, and the peritoneal cavity is then cleared of all fluid blood and clots, especial attention being paid to the lateral regions where the blood is liable to gravitate. Flushing with hot sterilised salt solution is often useful. When the surgeon is satisfied that the peritoneal cavity is clean, the pedicle is again examined to see if there is any oozing. If there is, the bleeding points must be secured; if not, the forceps are removed, the peritoneal edges of the divided tube stitched together, the pedicle dropped back into the pelvic cavity, and the abdominal incision closed without drainage. It may be advantageous to leave one or two pints of sterilised normal salt solution (temp. 100° F.) in the peritoneal cavity. The opposite tube and ovary should always be examined to see if they are healthy. If not, they should be removed.

In some cases the rupture of the tube occurs so close to the uterus

that the tear involves it. In these cases, the rent must be closed by sutures. More rarely, it has been necessary to perform partial hysterectomy to control the bleeding. In other cases there may be a ruptured extra-uterine foetation, and the bleeding may be occurring slowly or be insufficient in amount to produce immediately urgent symptoms. Under these circumstances, operation may not be undertaken until some time has elapsed. On opening the abdomen, clot in varying stages of organisation will be found; some of it will be closely adherent to the peritoneum, and the parts may be matted together. As much of the blood as possible should be removed, the adhesions carefully separated, and the affected tube excised. The abdomen may be completely closed, but in some cases it may be necessary to insert a small drainage tube through the lower end of the wound.

When the pregnancy has advanced up to the third or fourth month, operation may be required for secondary intra-peritoneal rupture with hæmorrhage. In these cases, the operation can usually be performed without difficulty and the placenta and foetus removed. In the later months, the separation of the placenta may be accompanied by severe hæmorrhage—especially if the foetus is living. The bleeding points must be seized and tied as the placenta is separated, but gauze packing may be required afterwards to control the hæmorrhage. In some cases it may be advisable to stitch the sac wall to the parietes and drain. The placenta should not be left behind and allowed to separate by sloughing, as the dangers of septic complications are very great, and secondary hæmorrhage may occur. When the foetus is dead, the separation of the placenta is not accompanied by much hæmorrhage.

ABDOMINAL HYSTERECTOMY FOR MYOMATA.

In the course of an abdominal operation, the surgeon may find that large myomata of the uterus are present which ought to be removed.

Abdominal hysterectomy may be either (1) sub-total or supra-vaginal, or (2) total or pan-hysterectomy. In the former, the body of the uterus and part of the cervix are removed; in the latter, the body and the whole of the cervix are taken away. If the ovaries and tubes are diseased, they should also be removed, but when they are healthy, one at least of the ovaries should be left behind on account of the importance of the internal secretion. Unless the patient is thin, and the whole tumour can be easily brought out of the wound on to the surface of the abdomen, the Trendelenburg position should be employed.

Sub-total hysterectomy.—The abdomen is opened below the umbilicus, but it may be necessary to prolong the incision upwards for some distance above the umbilicus, when the tumour is large. The intestines are displaced so as to expose the tumour, which is then examined

to determine the presence or absence of adhesions, and to see whether the tumour is impacted in the pelvis or not. Any adhesions are separated and the tumour is delivered into the wound, the intestines being packed away with abdominal cloths or towels. The delivery of the tumour may be facilitated by the use of special corkscrew-like instruments designed for the purpose. The broad ligament and Fallopian tube are then clamped between the ovary and uterus on each side. A second clamp is placed close to the uterus on each side, and the tube and ligament are divided between them. The round ligament of each side should be isolated, ligatured, and divided.

Instead of clamping the broad ligaments, the surgeon may transfix them by means of a pedicle needle between the uterus and ovary, and, after tying the ligatures, divide the broad ligament between them and the uterus, a second ligature or a clamp being applied close to that organ. The two layers of peritoneum forming the broad ligament are now easily stripped downwards until the uterine vessels are exposed at the lateral aspect of the uterus; these are isolated and secured by passing a ligature round them at the level of the internal os. The peritoneum is then divided on the anterior wall of the uterus just above the level of the internal os and stripped downwards; in doing this, care must be taken not to injure the bladder. The peritoneum of the posterior aspect of the uterus is similarly divided from one side to the other; here it is more firmly adherent and does not readily separate. The cervix is then cut across either transversely so as to leave a flat surface, or in a wedge-shaped manner with the apex downwards; the latter procedure is better. Probably, two or three vessels on the cut surface will require ligature. The cervical canal is examined to see if it is healthy; if not, the whole cervix must be removed (*vide infra*). If it is, the cut surface of the cervical canal is disinfected with pure carbolic acid and closed with two or three catgut stitches. The cut edges of the peritoneum are now brought together by a continuous suture, care being taken that the wall of the bladder is not included. In this way, both layers of peritoneum of the broad ligaments and of the cervix are united throughout, and no raw area is left; the line of union forms a straight line across the floor of the pelvis. The pelvic cavity is mopped free of blood, the abdominal cloths are removed, and the parietal incision closed in the usual way.

Total hysterectomy.—The steps of this operation are the same as those of the former up to the stage of ligature of the uterine vessels. The bladder is carefully detached from the upper part of the vagina and the anterior fornix is defined and opened transversely in front of the cervix. As the vagina is detached, it is held in volsella forceps, and the vaginal arteries are seized and ligatured; the posterior fornix is opened in a similar way. In order to avoid injury to the ureters, care must be taken to keep close to the cervix. When all the hæmorrhage has

been arrested, the cut edges of the vagina should be approximated by catgut sutures, and the peritoneum sutured over the divided parts as in sub-total hysterectomy.

ABDOMINAL MYOMECTOMY.

The operation of myomectomy for fibroids is sometimes to be preferred to hysterectomy. The operation consists in enucleating the tumours in the wall of the uterus or removing pedunculated fibroids. It is indicated when the fibroids are few in number, and in patients in the child-bearing period of life when they are anxious for a child. It is sometimes required in pregnancy, when the tumour appears likely to obstruct labour, and it may be done when the patient is old, and the fibroids are pedunculated and few in number. The chief difficulty in the operation is to control the bleeding, and in some cases it may be impossible to do this without having recourse to hysterectomy; the patient's consent to hysterectomy should always be obtained before undertaking the operation. The drawback to the operation is that the surgeon can never be certain that all the fibroids have been removed, or even that those removed are the ones which were causing the trouble; those not removed may go on growing, the symptoms may continue, and a hysterectomy be required later on. Nevertheless, if the patient is young and in the child-bearing period, it is never desirable to deprive her of the chance of being a mother if it can possibly be avoided. Myomectomy is theoretically the ideal operation, but practically it is not always possible, and it may be a more severe operation than hysterectomy.

The patient is placed in the Trendelenburg position, and the intestines packed off. The uterus is held up in the incision or brought out on to the abdominal wall. An incision is then made through the peritoneum over the fibroid and through its capsule, the latter being caught by two or three pairs of forceps. The fibroid is then enucleated with the finger or a blunt instrument. There may be a good deal of bleeding which is temporarily controlled by packing the cavity with gauze. The larger vessels are underrun with a catgut or silk thread, which is tied around the vessel. The cavity is obliterated by bringing the walls together with mattress-sutures, and the peritoneum is united by stitches passed close to the cut edges.

If the fibroid has a narrow thin pedicle, the latter may be transfixed and ligatured before it is divided, and, in order not to leave a raw area, the peritoneum is first incised all round the pedicle and turned back; this flap is subsequently replaced over the cut surface and sutured. Similarly, when the pedicle is broader and short, the peritoneum should be incised all round and reflected before the fibroid is enucleated. In these cases the pedicle should not be transfixed.

When the tumour is partly submucous, the uterine cavity may be opened. This will not interfere with the recovery of the patient, provided the uterine walls are accurately sutured afterwards. During pregnancy, the uterine walls are very soft and vascular; the sutures must be inserted therefore with great care and not pulled too tight. Mattress sutures are the most useful.

SUSPENSION OF THE UTERUS.

In the course of an abdominal section, it may be found that the uterus is badly retroverted or that there is marked tendency to prolapse, and the surgeon should be prepared to deal with this condition. A great variety of procedures are adopted, but perhaps the simplest is Gillian's operation, which adds little to the severity of the operation and may therefore be carried out at the same time. It consists in bringing the round ligaments forward through small separate incisions in the abdominal wall about an inch on each side of the middle line and fixing them so as to suspend the uterus in its proper position. The round ligaments are seized about $1\frac{1}{2}$ inches from the uterus and brought out through small incisions about an inch on each side of the vertical incision in the abdominal wall at a suitable level, so that a loop of the ligament lies on the abdominal wall in front of the anterior sheath of the rectus muscle. It is then stitched to the surface of that structure so as to bring about adhesion.

The above are the main operations on the female genital organs which the surgeon may have to perform unexpectedly in the course of an abdominal section, and which he must be prepared to carry out at once. Had space permitted, we would have gone more fully into the various conditions of the female genital organs which require laparotomy, because we are strongly of opinion that the operation should only be performed by a surgeon who is prepared to deal with any abdominal condition that may be met with, and that no one should open the abdomen who is only able to treat some special organ. The various other procedures—such as hysterectomy for cancer of the uterus—are usually diagnosed before operation is undertaken, and the surgeon can therefore carefully plan out his procedure beforehand.

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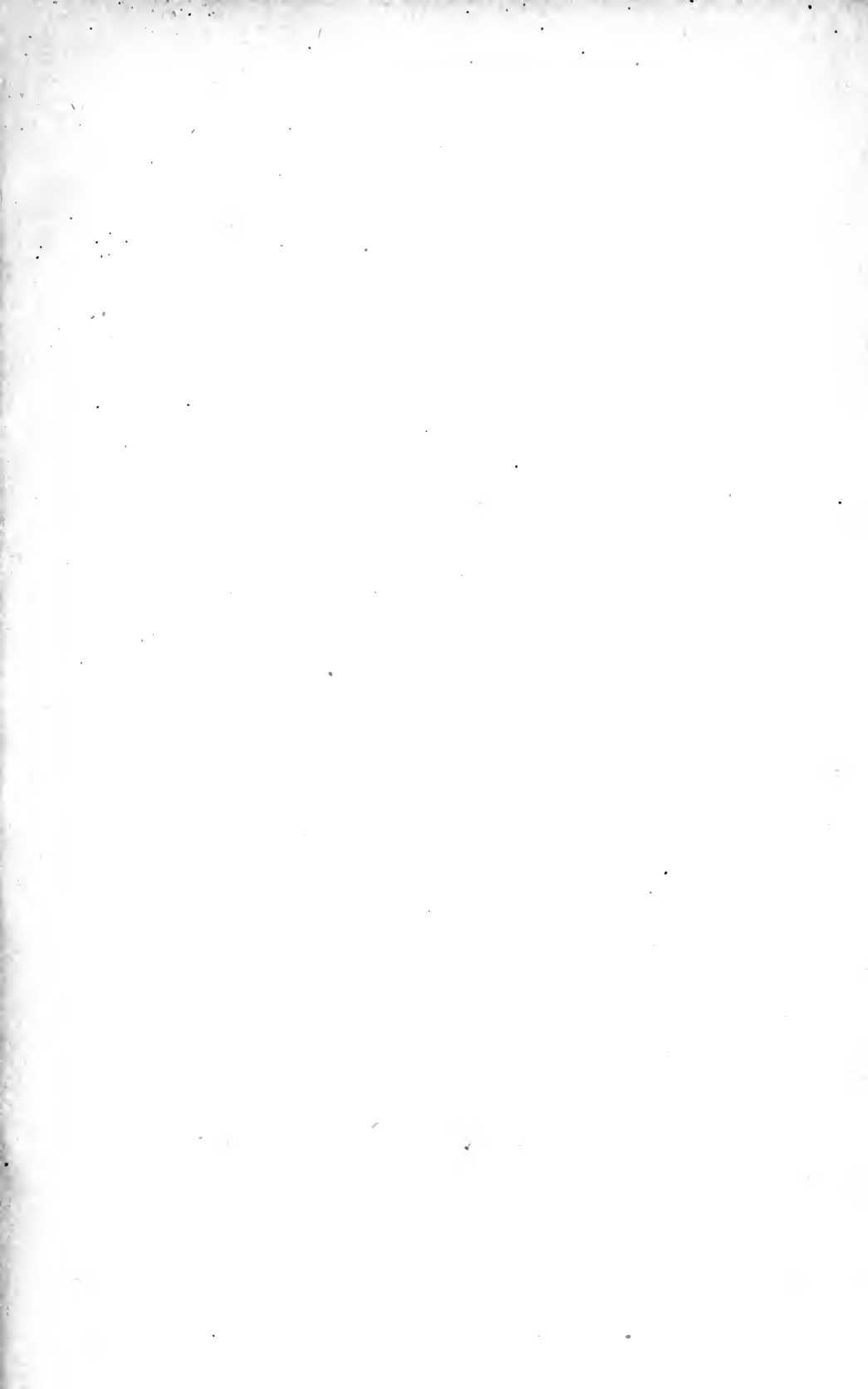
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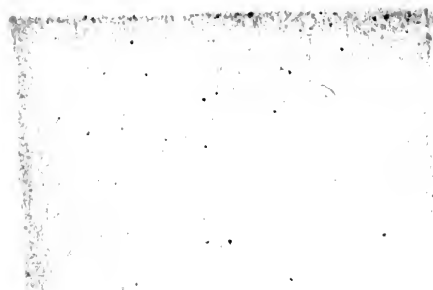
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